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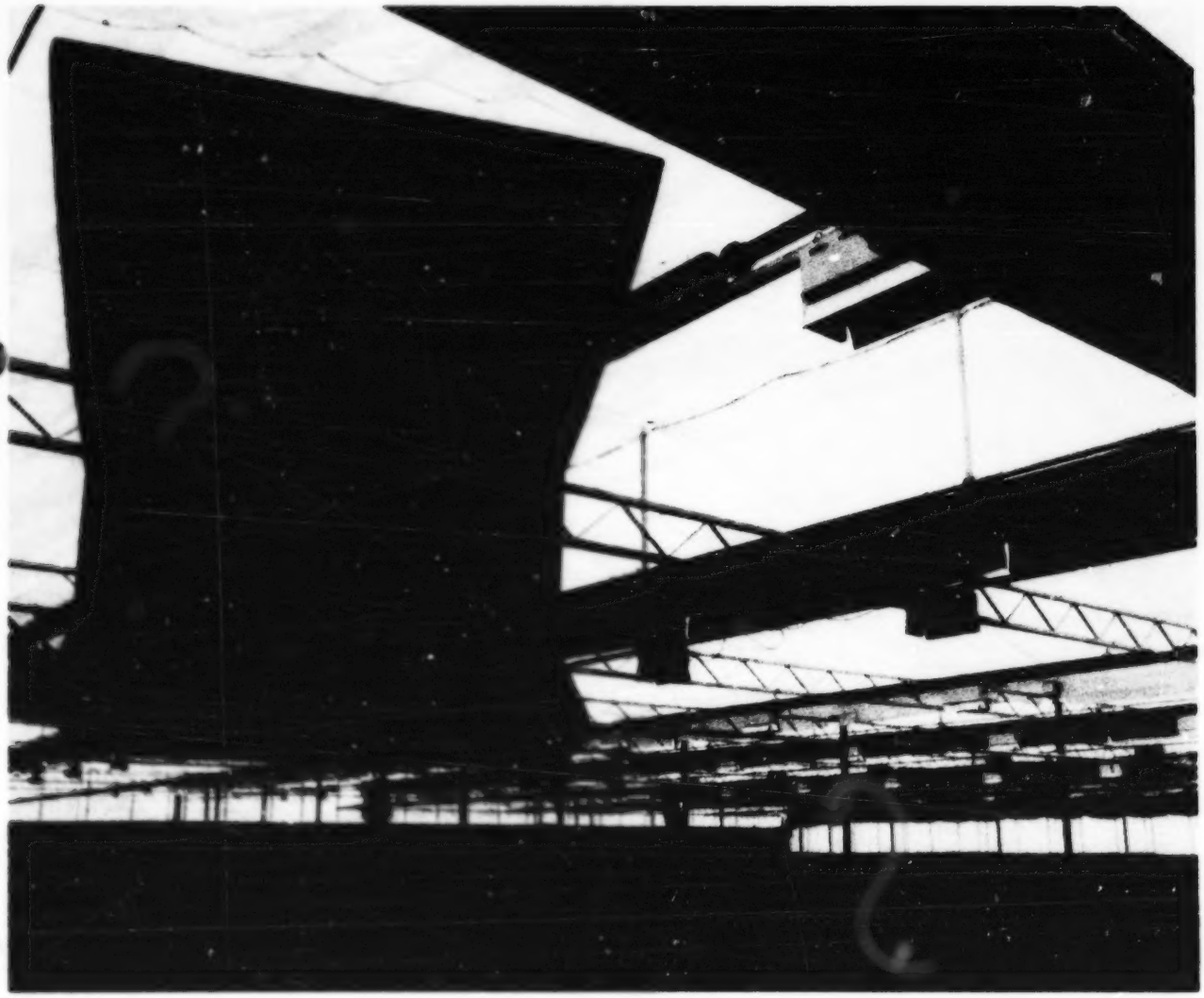
PESTICIDE RECOMMENDATIONS for GREENHOUSE ORNAMENTALS



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The recommendations contained in this publication have been prepared in consultation with:

—Ontario Crop Protection Committee
—Ontario Ornamental Research Committee

and personnel of:

—Plant Industry Branch, Ontario Ministry of Agriculture and Food
—Ontario Agricultural College, University of Guelph
—Agriculture Canada
—Ontario Ministry of the Environment
—Ontario Ministry of Labour
—Health and Welfare Canada
—Horticultural Research Institute of Ontario

EXTENSION HORTICULTURISTS
ONTARIO MINISTRY OF AGRICULTURE AND FOOD

Counties Served/Specialty	Name	Address	Phone No.
Greenhouse Flowers	John Hughes	Hort. Science Dept., U. of Guelph	519-824-4120 ext. 8910
Greenhouse Flowers & Nursery	Wayne Brown	Vineland Station, L0R 2E0	416-562-4142
Marketing	Bob Cobbledick	Vineland Station, L0R 2E0	416-562-4142
Eastern Ontario	Steve Rowe	College of Agricultural Technology Kemptville, K0J 1G0	613-258-3411
Prince Edward, Hastings	Jody Bodnar	P.O. Box 470, Picton, K0K 2T0	613-476-322[illegible]
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Durham, Ontario, Victoria	Bev Ells	234 King St. East, Bowmanville, L1C 1P5	416-623-3348
York County and Bradford Marsh Area	Matt Valk	Bradford Muck Research Station, R.R. 1, Kettleby, L0G 1J0	416-775-3783
Simcoe, Dufferin, Grey	Ken Wilson	P.O. Box 69, Clarksburg, N0H 1J0	519-599-2042
Halton, North Wentworth, Peel	Joe Uyenaka	181 Main St., Milton, L9T 1N7	416-878-2314
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Oxford, Elgin	Keith Priest	P.O. Box 666, Woodstock, N4S 7Z5	519-537-6621
Lambton, Middlesex, Huron	John Gardner	195 Dufferin Ave., 4th Floor, London, N6A 1K7	519-434-6811
Essex	Clem Fisher Leslie Huffman	Harrow, N0R 1G0	519-738-2251
Kent	Ed Tomecek	College of Agricultural Technology, Ridgetown, N0P 2C0	519-674-5456
Provincial Potato Specialist	Sam Squire	P.O. Box 370, Alliston, L0M 1A0	705-435-5521
Extension Pathologist	Craig Hunter	P.O. Box 246, Simcoe, N3Y 4L1	519-426-7120

In the event of a problem arising in connection with special pests, spray mixtures or spraying, telephone or write to the Extension Horticulturist serving your area.

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All information and recommendations contained in this publication relating to the use of pesticides have been reviewed by the Ontario Pesticides Advisory Committee.

In this publication most recommendations list several pesticides that are effective for each insect or disease discussed. Where possible, the less hazardous materials and those that growers have used satisfactorily for a number of years are listed first. These are followed by the more toxic pesticides and/or newer ones with which we have less experience. It must be emphasized that in some cases the most effective pesticides are highly toxic.

The effectiveness of pesticides and plant injury by control chemicals is influenced by the weather and other conditions. Consult the package label and other information regarding compatibility with other materials, the effect of high or low temperatures, poor drying conditions, etc. Wettable or soluble powder (WP and SP) preparations generally are less likely to cause plant injury than liquid concentrate (EC, SC and F) formulations.

The recommendations are for commercial greenhouse growers. Homeowners should use products intended for houseplants in homes and which are labelled "domestic." See Ontario Ministry of Agriculture and Food Publication 64, *Insect and Disease Control in the Home Garden.*

The pesticides listed in this publication are registered by Agriculture Canada, Ottawa. A pesticide should not be used on any crop unless it has been registered for that crop. Users are warned that labels on formulated pesticides imported for their own use may carry recommendations not approved of by the Ontario Crop Protection Committee.

PRECAUTIONS WITH ALL PESTICIDES

1. Always read the label before opening pesticide containers, and follow all precautions and directions.

2. Never smoke, chew tobacco or eat while handling or applying pesticides. **Do not** carry such items in clothes for spraying.

3. Always wear neoprene gloves to handle the concentrate, and when coming in contact with dilute spray i.e. cleaning nozzles, and pumps, and handling contaminated spray equipment.

4. Inhalation of spray droplets, dust or fumes should be avoided.

   Wear a respirator to reduce pesticide inhalation especially when handling dusty formulations or volatile concentrates. For gases a self-contained breathing apparatus may be required.

5. Wear freshly laundered clothes each day, including caps. Regularly wash gloves and boots.

   Avoid spilling pesticides on skin or clothing.

6. Avoid contamination of water supplies, wells, ponds, streams, etc. with pesticides when filling or flushing spray equipment. Never fill a sprayer directly from a stream, pond or wells unless the unit is equipped with an anti-backflow device to prevent siphoning.

7. Keep a record of the common names of all pesticides handled and especially those listed as hazardous in this publication. This list should be known by members of your family in the event of an accident. You can use this book, see Table 18.

IF ACCIDENTS OCCUR

1. If an accident occurs, remove contaminated clothing including under clothes immediately, and wash contaminated skin thoroughly with soap and water. Wash all clothing including caps, gloves and boots before reuse.

2. If clothing becomes wet with a pesticide, when spraying remove it immediately. When the spray operation is complete, remove all contaminated clothes including under clothes, have a bath or shower and put on freshly laundered clothing.

3. If symptoms of illness occur during or shortly after handling or applying a pesticide, get the patient to a hospital immediately. Take the list of common name chemicals with you to the hospital (see Emergency Procedures for Pesticide Poisoning).

4. Clean up any pesticide spills immediately. Use dry soil or other absorbent material to remove excess liquid. If the spill is major, contact the nearest office of the Pesticide Control Service for advice. (See list page 6)

FIRST-AID INFORMATION

The Occupational Health and Safety Division, Ministry of Labour, 400 University Avenue, Toronto, M7A 1T7, has physicians available for consultation on first-aid information and advice. They can be contacted:

Between 8:00 a.m. and 5:00 p.m. Monday to Friday. Telephone (416) 965-3610.

During weekends, public holidays and non-office hours. Telephone (416) 965-1211 and ask for the "on-call" physician.

National Poison Centre — telephone (613) 992-0879
Health and Welfare, Canada
Ottawa

EMERGENCY PROCEDURES FOR PESTICIDE POISONING

If a pesticide is spilled onto clothing or parts of the body remove clothing including under-garments and wash skin and hair with water or soap and water if available. Flush eyes with plenty of water.

Should a person exhibit symptoms of poisoning such as weakness, slow heartbeat, incoordination, tremors, abdominal cramps, salivation, or blurred vision but is still conscious, seek medical help immediately by rushing the patient to the emergency ward of the nearest hospital. If the patient is unconscious call an ambulance.

Always know the common name of the chemical being used. Get this from the label or from the list mentioned above or use this book for reference.

RELATIVE HAZARD TO HUMANS OF PESTICIDES RECOMMENDED ON GREENHOUSE ORNAMENTALS

Extreme and High Hazard

Wear a chemical cartridge respirator with a dual chemical cartridge suitable for the pesticide to be used for protection against most pesticides. It is recommended for outside use against light concentrations of pesticides. This type of respirator and cartridge should be used along with rubber or neoprene gloves, rubber boots and protective eye shields when handling or mixing any of the pesticides listed below. It is also worn when applying extremely toxic or highly toxic compounds outdoors.

Extreme Hazard	**High Hazard**
Dasanit (Fensulfothion)	DDVP Smokes (Dichlorvos)
Methyl Bromide	Nicotine Sulfate
Sulfotep	
Temik (Aldicarb)	

Moderate Hazard

These pesticides are dangerous through inhalation, skin contact or if taken by mouth. A few grams can be fatal. Always wear protective clothing when mixing or applying these chemicals. Avoid mixing in windy areas and dispose of containers properly. Always change clothing and wash immediately after using these materials.

Diazinon	Meta Systox R (oxydematon methyl)
Lesan (Fenaminosulf)	Acti-Dione PM (cycloheximide)
Lindane	Pirimor (pirimicarb)

Thiodan (Endosulfan)

These pesticides are dangerous if handled carelessly. Caution is required to insure that they are not taken internally or allowed to contact the skin. Wear protective clothing, including respirator and goggles, when mixing or working with them in confined areas. Avoid breathing the vapors. Triple rinse and dispose of containers properly. Always change clothing and wash up immediately after using these materials.

Low Hazard

Pesticides listed in this calendar and not appearing on this list are less toxic, but should be handled with all precautions listed on the label. Even the most toxic pesticide can be used safely, if used properly, by following all directions and precautions listed on the label.

SPECIAL INSTRUCTIONS

It should be emphasized that all pesticides are toxic and must be handled safely. In addition, a number of pesticides (insecticides, fungicides and herbicides) have major deficiencies in their toxicological information because many tests were conducted by the Industrial Biotest Laboratory (IBT) and some of these were invalid .Replacement studies are currently being conducted by the respective registrants. Those handling and applying these chemicals must pay special attention to the precautions outlined above.

At the time of this publication, the pesticides included are:

CSA COMMON NAME (Generic Name)	TRADE NAME
disulfoton	Di-Syston
endosulfan	Thiodan
etridiazole	Truban
naled	Dibrom
nicotine sulphate	Nicotine, Black Leaf 40, Schedule 1
oxydemeton-methyl	Metasystox-R

BLOOD TESTS FOR THOSE APPLYING PESTICIDES

Organophosphorus and carbamate pesticides are capable of inactivating and depressing the serum and red blood cholinesterase levels. If the activity of cholinesterase falls below a critical level, human poisoning can result as exhibited by fatigue, dizziness, nausea, trembling, blurred vision, difficulty in breathing and other symptoms. For those working outdoors and applying these groups of pesticides it is strongly recommened that cholinesterase levels be checked by your family doctor. To be of value the tests should be commenced prior to using these pesticides and not after applications have commenced since the normal level per individual can vary considerably making it difficult to assess the degree of suppression. In this publication the primary insecticides of concern are: Dasanit (Fensulfothion), Parathion, Sulfotep, Temik (Aldicarb), DDVP Smokes (Dichlorvos), Diazinon, Meta-Systox R (oxydemeton methyl) Pirimor (Pirimicarb).

PROTECTIVE CLOTHING WHEN USING PESTICIDES IN GREENHOUSES AND OTHER ENCLOSED AREAS

Respiratory Protection — Available Devices

Air-Purifying Devices — Canister Gas Masks

Canister gas masks have been used effectively for many years by greenhouse applicators for respiratory protection against certain gases, vapors and particulate matter which otherwise might be harmful to life or health.

From a practical standpoint, canister gas masks are generally suitable for ventilated areas not subject to rapid change, but should never be used in confined spaces where oxygen deficiency and high gas concentrations may occur.

Working Conditions

High Concentrations

(a) Use only a self-contained breathing apparatus e.g. Scott, Air Pak

(b) High concentration of toxic gases, vapors or particularly matter can be produced when dispensing extremely or highly toxic pesticides such as parathion, nicotine and naled (Dibrom):

  (i) through fogging machines
  (ii) by means of smoke bombs
  (iii) as spray applications

In such instances self-contained breathing apparatus is recommended.

Low Concentrations

Canister gas masks may be used when the ambient air contains low concentrations of toxic gases, vapors or particulate matter derived from soil-drench, granular, dust, or foliar

spray applications. Pesticides applied in such manner are usually of moderate to low toxicity. The exceptions include aldicarb (Temik 10G) and fensulfothion (Dasanit 15G) but the wearing of canister gas masks provides protection.

Contact your safety supply company for the proper canister selection.

Other Clothing

When measuring, mixing and applying pesticides, wear neoprene or rubber gloves, rubber boots, a protective apron or coveralls, hat, and protective eyeshields or a full-face mask.

METHYL BROMIDE AND INSECTICIDE SMOKES

A permit issued by the Ontario Ministry of the Environment is necessary to use methyl bromide (MC-2 and MB-C_2). To apply for a permit contact:

Agricultural & Industrial Chemicals Section
Ontario Ministry of the Environment
135 St. Clair Avenue West
Toronto, Ontario
M4V 1P5
Telephone:
(416) 965-2401

When using methyl bromide or insecticide smoke generators, suitable protective clothing must be worn. After treatment, the greenhouse must be barricaded and warning signs posted. In general, smokes are especially useful for small greenhouses of 930 m^2 or less. Smoke applications are not satisfactory for spot treatment.

For methyl bromide, soil temperature should be above 15°C.

REENTRY TO TREATED AREAS

Pesticide poisoning may occur where workers enter greenhouses too soon after pesticides have been applied. Such poisoning can result from handling treated plants or from inhalation of pesticide vapors. Examine the pesticide label for precautionary statements on working in treated areas.

For all materials in the form of smokes, aerosols or vapors, lock and post the greenhouse and ventilate to ensure safety before working in the greenhouse. The minimum interval between application and reentry for these products is 12 hours.

The pesticides listed below are those for which a specified minimum interval must be observed from the time of application to the time of working in the crop.

Minimum reentry time of 48 hours for

Dasanit (Fensulfothion)
Temik (Aldicarb)

The specified reentry period refers to the treated bed, ground bed, or bench specifically treated with these materials and not to the greenhouse range as a whole.

Storage

1. General Storage:

The Ontario Pesticides Act and Regulation 751 require that all pesticides be kept out of the reach of children, irresponsible persons, pets and livestock. They should be stored in a locked facility away from food for humans, and feed for animals. Herbicides should be stored separately from other pesticides to avoid possible contamination.

Special Storage:

Schedule 1, 2 and 5 pesticides must be stored in a storage facility which is ventilated to the outside atmosphere. A placard bearing the words **"Chemical Storage Warning — Authorized Persons Only"** in block capitals must be affixed to the outside of each entrance. Entry to the storage facility should only be made by the person responsible for the pesticide, or with his permission.

2. **Always store pesticides in original containers and keep them tightly closed. Never put pesticides in unmarked containers.** See also OMAF Factsheet, *Farm Storage of Pesticides*, Agdex 607.

3. Post pesticide storage areas with proper notices.

4. In areas where flooding has been a frequent occurrence, fertilizers and pesticides must be stored above the known high water mark to avoid contamination of the flood waters. Contamination of water by these chemicals can and has led to serious health problems, affecting humans, domestic animals as well as fish and wildlife.

Disposal of Pesticide Containers and Contaminated Material

1. Containers from pesticide packages, and any paper or other material used to clean up spills, should be buried or burned. Make sure that people and animals are kept away from the smoke, and the smoke is not directed toward buildings, highways, roads, or outdoor public areas.

2. Un-rinsed containers can contain as much as 3% of the original formulation. If this amount of toxic pesticide is discarded with the drum it could be dangerous to other people handling it, or to the environment (For example, your water supply). Failure to rinse is also wasteful — why not use that 3% for the purpose for which it was purchased, i.e., to control the pest!

   Rinse all empty metal or glass containers three times with water and add washings to the spray tank. Or, use a rinsing device. These rinsers can be used to puncture the bottom of a metal or plastic drum, and to rinse the residual left in the container directly into the spray tank. This procedure takes less than a minute and results in a rinse container. The rinsed containers may be crushed, buried and covered by a least 50 cm of soil, away from any watercourse or water table.

SHELF LIFE OF PESTICIDES

Most pesticides, if stored in a cool (not freezing), dry place, will remain effective for 2 years or more.

It is a good idea to mark the date of purchase on the package.

The following is only a guide to check effectiveness of pesticides that have been stored.

Formulation	Discard material if:
Dust	excessive lumping is evident;
Emulsifiable and spray concentrate	the solution does not turn milky when mixed with water or if the mixture separates or if a sludge forms;
Granulars	excessive lumping or caking is evident, and it does not run freely;
Oil sprays	a milky solution does not form when mixed with water;
Wettable powders	material is lumpy and powder will not mix with water.

TYPES OF APPLICATION EQUIPMENT

1. **Spraying** is one of the most widely used and effective methods of applying pesticides. The nozzles should be clean and pressure maintained to achieve a fine spray which will result in uniform coverage when the mixture is applied up to the point of runoff. Complete coverage is the objective; be sure to spray thoroughly both lower and upper leaf surfaces.

2. **Fogs** are produced by several kinds of machines. These machines all use heat from different sources to vaporize the pesticide. Fogging can be a very efficient method of pesticide application provided the operator follows basic instructions.

3. **Granular Application** Several types of applicators are available for applying granular pesticides. Commonly used devices are shaker bottles and cyclone spreaders. Be sure the applicator does not grind or fracture the granules.

4. **Dusters** are used to a very limited extent as it is difficult to get good coverage on the underside of foliage and the dust is considered unsightly on the foliage at time of sale.

5. **Smokes** are a very simple but effective means of pesticide application. There is no equipment involved; containers are simply placed on the path and lighted .Growers should be cautioned against using smokes in very old, loose greenhouses or during high winds.

WETTING AGENTS

In the following discussion, the term "wetting agent" will be used to include spreaders, stickers and surfactants, although these terms do have slightly different meanings.

A wetting agent is used to allow the pesticide to spread evenly over the foliage. Most pesticides are formulated with a wetting agent in them, but in some cases, due to the temperature of the water or air, hardness of the water, type of leaf surface, stage of plant growth and/or the type of formulation, the amount may not be adequate. Consult the label for specific recommendations.

A simple method of determining if the amount of wetting agent present is sufficient is to spray about 3 metres of bed area. Examine to see if both the upper and lower surfaces of leaves of different stages of growth are uniformly wetted with a light film of the spray.

If not, add 125 mL of spreader per 1000L of spray. Spray another 3 metres of bed and reexamine. Continue until the wetting is satisfactory.

Wetting agents help the spray solution to "wet" powdery mildew mycelium and improve control. The use of an excessive amount of wetting agent can result in plant damage, excessive foaming, which will cause pumping problems or "runoff" resulting in poor control.

RECOMMENDATIONS RE SPRAY-TANK MIXTURES IN ALKALINE WATER

Because many pesticides are susceptible to alkaline water, it is recommended that pesticides diluted with alkaline water be used immediately.

However, "spray immediately" is not always possible owing to unexpected reasons. Any delay in applying spray mixtures will result in pesticide loss due to degradation[1] and possibly a corresponding decrease in control.

To avoid this possibility, it is recommended that alkaline water be neutralized before adding any pesticides. Dissolve potassium or ammonium dihydrogen phosphate at the rate of 50 g per 100 litres of water, and then add pesticides.

The phosphate is not always necessary, but this practice is a sort of insurance. The cost of the phosphate is substantially less that that of the pesticides. Also, the added phosphate will be available as a foliar nutrient.

Occasionally water-soluble fertilizers are used with pesticides as a tank mixture. This practice is not encouraged because most of the water-soluble fertilizers are strongly alkaline. If these fertilizers are used, the amount of phosphate recommended above is not sufficient to neutralize the water.

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[1] *The rate of degradation is dependent on the pesticide, the concentration of pesticide in the tank (dilution factor), and temperature.*

PESTICIDES CONTROL FIELD OFFICES

Ontario Ministry of the Environment

COUNTY	DISTRICT	TELEPHONE
Essex, Kent, Lambton	H.E. Collins, P.O. Box 237 435 Grand Ave. West, Chatham N7M 5K3	519-352-5107
Southwestern Region		
Elgin, Middlesex, Oxford	D.C. Morrow & W. Lampman 985 Adelaide Street South, London N6E 1V3	519-681-3600
Haldimand, Norfolk, Niagara, Hamilton, Wentworth	J. Percy, Ontario Government Building 119 King St. W., Hamilton L8N 3Z9	416-521-7640
Simcoe, Muskoka	W. Cowie, 12 Fairview Road, Barrie L4N 4P3	705-726-1730
West Central Region		
Dufferin, Wellington, Waterloo, Brant	R. Miller, P.O. Box 219, 400 Clyde Road Cambridge (Galt) N1R 5T8	519-623-2080
Bruce, Grey, Huron, Perth	B.T. Lobb, 20 King Street, P.O. Box 688 Ontario Ministry of Agriculture & Food Bldg., Clinton N0M 1L0	519-482-3428
Central Region		
Halton, Peel, York, Durham, Toronto	T. O'Neill & D. Trenholm, 150 Ferrand Drive Suite 700, Don Mills M3C 3C3	416-424-3000 (Ext. 204)
Peterborough, Victoria, Haliburton, Northumberland	A.G. Carpentier, 139 George Street N. Peterborough, K9J 3G6	705-743-2972
Frontenac, Hastings, Lennox & Addington, Prince Edward, Leeds & Grenville	D.A. Raddon, 133 Dalton St. Box 890, Kingston K7Z 4X6	613-549-4000
Southeastern Region		
Prescott & Russell, Renfrew, Stormont, Dundas & Glengarry, Ottawa-Carleton, Lanark	R.P. Cameron 2378 Holly Lane, Suite 204, Ottawa K1V 7P1	613-521-3450
Manitoulin, Nipissing, Parry Sound, Sudbury	D.J. Mewett, Northgate Shopping Centre 1500 Fisher St., North Bay P1B 2H3	705-476-1001
Northeastern Region		
Cochrane, Timiskaming, Algoma	P. McCubbin, 83 Algonquin Blvd. W., Timmins P4N 2R4	705-264-9474
	Sault Ste. Marie	705-949-4640
Kenora, Rainy River, Thunder Bay	G.R. Gammond, Ontario Government Building Thunder Bay "F" P7E 6E3	807-475-1305
Head Office	Pesticides Control Section 135 St. Clair Avenue West, Suite 100 Toronto M4V 1P5	416-965-2401

PESTICIDE REGULATIONS

An agriculturist may be briefly defined as a person who farms a minimum of 11 contiguous acres or has a minimum farm income of $12,000. At the present time an agriculturist can buy and use pesticides in schedule 2, 3, 4, 5 and 6.

A license to purchase and use methyl bromide can be obtained from your local Pesticides Control Officer or from:

Ministry of the Environment
Pesticides Control Section
135 St. Clair Ave. W.
Toronto, Ontario
M4V 1P5
Telephone. (416) 965-2401

PREVENTIVE vs ERADICANT PROGRAMS

The old adage "an ounce of prevention is worth a pound of cure" is best applied to a pest-control program. Failure to conduct a timely preventive program often results in total crop failure because the product is either not marketable or is greatly reduced in market value. The expenditure for a small amount of pesticide applied on a regular basis is the best protection against needless crop failures. In short, you are gambling a few pennies of prevention against many dollars of last-minute eradication and the possibility of total crop failure.

The use of yellow "sticky" boards can be useful in attracting insects in the greenhouse in order that identification and estimates of numbers can occur.

PESTICIDE RESISTANCE

Occasionally, apparent poor results may be obtained after applying pesticides. Some reasons may be as follows: improper dilution caused by not checking the label directions, poor coverage due to poor application technique or lack of a wetting agent, resistance buildup due to continuous use of one chemical. Organisms which exhibit reduced sensitivity to a pesticide are called resistant. Many of the pesticides recommended have a very specific mechanism of action, that is, they act on a single system or site in the organism. These materials should not be used continuously and repeatedly in a season-long program since this will increase the chances of the development of pest resistance. Examples of these types of compounds are Benlate and Ambush.

Resistance can be delayed or prevented by the early use of control programs designed to avoid continuous or long-term exposure to a pesticide. In our recommendations we suggest that single-site compounds be alternated with other pesticides. To help overcome a resistance problem, occasionally alternate with another recommended material from a different chemical family.

PESTICIDE TOXICITY

Common Name	(Trade Name)	LD_{50} (mg a.i./kg)*	Chemical Family**
Insecticides and Miticides			
Acephate	(Orthene)	866	OP
Aldicarb	(Temik)	1	Carbamate
Bacillus thuringiensis	(Dipel) (Thuricide)	non-toxic	Biological
Carbaryl	(Sevin)	560	Carbamate
Chlordane	(Chlordane)	457	OC
Chlorpyrifos	(Lorsban) (Dursban)	135	OP
Cyhexatin	(Plictran)	540	Organotin
Demeton	(Systox)	2.5	OP
Diazinon	(Diazinon)	300	OP
Dichlorvos	(DDVP)	80	OP
Dicofol	(Kelthane)	684	OC
Dienochlor	(Pentac)	3160	OC
Dimethoate	(Cygon)	215	OP
Disulfoton	(Di-Syston)	2.6	OP
Endosulfan	(Thiodan)	110	OC
Fenbutatin oxide	(Vendex)	2631	Organotin
Kinoprene	(Enstar)	5000	IGR
Lindane	(Lindane)	88	OC
Malathion	(Malathion)	1400	OP
Mevinphos	(Phosdrin)	5	OP
Naled	(Dibrom)	430	OP
Nicotine	(Nicotine)	50	Botanical
Oxydemeton-methyl	(Metasystox-R)	75	OP
Oxythioquinox	(Morestan)	2500	Carbonate
Parathion	(Parathion)	3.6	OP
Permethrin	(Ambush) (Pounce)	4000 +	Syn. Pyr.
Pirimicarb	(Pirimor)	147	Carbamate
Sulfotep	(Sulfotep)	10	OP
Tetradifon	(Tedion)	14700 +	OC
Trichlorfon	(Dylox)	560	OP
Fungicides			
Benomyl	(Benlate)	10000 +	Ben.
Captan	(Captan)	9000	Ph.
Carboxin	(Vitavax)	3820	Ox.
Chlorothalonil	(Exotherm Termil) (Daconil 2787)	10000 +	Arom.
Copper Sulphate			Copper
Cycloheximide	(Acti-dione P.M.)	2.5	Antibiotic
Dichloran	(Botran)	10000 +	Dicarb.
Dinocap	(Karathane)	1190	Dinitro
Dodemorphace-tate	(Meltatox)	4180	Morph.
Etridiazole	(Truban)	1077	Thia.

(Continued on Page 8)

(Cont'd from Page 7)

Fenaminosulf	(Lesan)	60	Arom.
Ferbam	(Ferbam)	17000 +	Dithio.
Folpet	(Phaltan)	10000 +	Ph.
Iprodione	(Rovral)	3500	Dicarb.
Oxine benzoate	(No-Damp)		Arom.
Maneb	(Manzate)	6750	Dithio.
Quintozene	(Quintozene)	30000	Arom.
Streptomycin	(Agri-mycin)	9000	Antibictic
Triforine	(Funginex)	6000 +	EBI
Zineb	(Zineb)	5000 +	Dithio.

***The relative toxicity of a pesticide may be referred to as its LD_{50}. This is the amount of the active ingredient (a.i.) of the chemical in milligrams used per kilogram of test animal (usually female rats) that kills 50% of the test animals. This is commonly measured as the Acute Oral LD_{50} (above) which refers to the chemical ingested through the mouth or nose. Dermal LD_{50} figures, or skin penetration, are also available. The higher the LD_{50} figure the less toxic the product is to humans.**

***OP = Organophosphorus, OC = Organochlorine, IGR = Insect growth regulator, Syn. Pyr. = Synthetic pyrethroid**

Ben. — benzimidazole
Ph. — phthalimide
Ox. — Oxithiin
Dicarb. — dicarboximide
Dinitro — dinitrophenol
Morph. — morphactin
EBI — ergosterol biosynthesis inhibitor
Thia. — thiadiazole
Arom. — Aromatic hydrocarbon

CLEANLINESS AND SANITATION

Sanitation is the first step in any pest-control program. If a source of infection is constantly present, pest-control programs will be expensive and frustrating.

(a) Remove dead and dying leaves and flowers.

(b) Keep walks and the surface of beds clean.

(c) Control weeds in and outside greenhouses.

(d) Hang up the ends of hoses.

When bringing new stock into the greenhouse, check carefully for possible infestations.

Cleanliness in itself will not control pest problems but is a basic part of any control program.

SOIL PASTEURIZATION

Soil is pasteurized to eliminate organisms that could be harmful to the plants that will be grown. Ideally this is accomplished without injuring beneficial soil organisms.

Soil should be in fine tilth to allow rapid, uniform penetration of the steam fumigant. Soil should be free from clods, large lumps and undecomposed crop remains.

The following chart gives an idea of the time-temperature relationships necessary to destroy undesirable organisms.

Weeds (most)	70°-80° C for 15 min
Insects & Mites	60°-71° C for 20 min
Bacteria (most)	60° C for 10 min
Fusarium	57° C for 30 min
Botrytis	55° C for 15 min
Nematodes	55° C for 15 min
Rhizoctonia	52° C for 30 min
Sclerotinia	50° C for 5 min
Pythium	46° C for 40 min

As can be seen from the chart, most organisms of concern to growers can be eliminated under ideal conditions of 60°C for 30 minutes. Above 82° C beneficial soil organisms start to be destroyed. If the soil is heated at too high a temperature for too long a time, it becomes sterile and subject to a greater degree of infection than previously, simply because all organisms have been destroyed. There are many other undesirable effects of over-steaming including:

(a) excessive ammonia release

(b) manganese toxicity

(c) higher total salts levels

(d) destruction of organic matter.

Methods

(1) Steam is the most common source of heat for pasteurization today. Steam is fast, efficient, effective and as economical as any system. There are different ways of handling steam, depending upon the type of crop being grown. Pot plant growers find it most efficient to inject steam into the bottom of a wagon or old truck body. After cooling, the pasteurized soil can be moved as a mass to the area in which it will be used.

Growers of cut flower crops follow two main techniques. If their ground beds are drained with agricultural tile (top of tile 40 cm below the surface and rows on 60 cm centres), it becomes a very simple matter to inject steam into these tiles and very effectively pasteurize the soil to the sides and above them. If tiles are not installed, then the steam is injected directly under a trap covering the bed through either a canvas hose or a perforated, flexible pastic field tile for even distribution.

(2) Aerated steam is being used more widely today. In this system, live steam is mixed with air in a chamber and the mixture (at 70° C) is used to pasteurize soil. The lower steam temperatures allow the soil to be pasteurized and avoid any of the hazards of oversteaming. Unless there are specific problems, soil temperatures of 70° C are adequate for most insect and disease problems.

(3) Electric soil pasteurizers are useful where small volumes of soil are used and no other method is available. Overcooking the soil can occur very easily because in order for the temperature between the finned heat source to reach 82°C, the fins themselves must be at a higher temperature.

(4) The use of chemical fumigants uch as Basamid, Methyl Bromide, Telone II, Vapam and Vorlex as a method of soil pasteurizing has become more popular with the high cost of steaming. Each of the fumigants mentioned has a specific rate and activity against soil-borne insects, diseases, nematodes and weeds. Crops in adjoining beds or benches may have to be guarded. Consult the label for recommendations and cautions. The bromine residue that lingers in the soil after using Methyl Bromide may reduce the germination of and/or growth of salvia, dianthus, ageratum, alyssum, antirrhinum, aster, calendula, celosia, chrysanthemum, cleome, coleus, coreopsis, dahlia, digitalis, godetia, helichrysum, iberis, lobelia, matricaria, myosotis, nemesia, nierembergia, portulaca, salpiglossis, verbena, viola and vinca.

BENCH AND EQUIPMENT STERILIZATION

Bench and equipment sterilization are a part of every greenhouse management program. To help eliminate disease and insect pests, all production equipment should be as clean as possible. Tools, potting benches, carts, walkways and growing benches should be sterilized between crops.

For a general greenhouse cleanup, use a commercial disinfectant such as a chloride bleach, e.g., Javex at 1 pt 6% bleach in 9 parts water. Ventilate the work area after treatment.

Remember also to sterilize automatic watering systems, everything in the propagating area and to clean your hands between crops or houses. If available, a steam hose is ideal to clean tools, wheelbarrows, etc.

WOOD PRESERVATIVES

Only copper napthanate is recommended as a safe wood preservative for greenhouse use. Allow at least a week to elapse before placing plants on or near freshly treated wood. Some injury has occurred on poinsettias with copper napthanate. Two commonly available wood preservatives, creosote and pentachlorophenol, are excellent materials **but** can be extremely injurious to crops. Both the fumes and direct contact with plants will cause the damage. Therefore, do not use these materials around or in a greenhouse. Wolmanized lumber is recommended for greenhouse use.

SOIL DRENCHES

Soil drenches are not meant to replace a thorough pasteurization program in the greenhouse. They are useful in preventing recontamination or as an eradicant to eliminate pathogens in the soil or basal parts of the plant.

Some drenches are taken up by the roots of the plant from the soil. In this case, the drenches are systemic and the whole plant is effectively treated against pests. As a general rule, apply 1.2 L of drench per 0.1 m^2 of bench area or 300 mL of drench per 15 cm pot. Follow the manufacturer's directions carefully.

COMPATIBILITY OF PESTICIDES

The pesticides recommended in this publication are for individual application to the crop. Before mixing pesticides, read the product label carefully for compatibility statements and contact the supplier.

Avoid mixing EC formulations. Herbicides should never be mixed with fungicides and insecticides. Apply with spray equipment reserved for herbicide use only.

TEMIK 10G

Temik 10G is a highly toxic pesticide that must be used with caution. It is a granular product that provides systemic control of certain insects and mites. The Temik granules should be applied evenly at the rate of 500 g/100 m^2 of plant bed or closely packed pots. The registered crops Poinsettias and Chrysanthemums should be established at least 3 weeks before the first application. Use an applicator that does not grind the granules such as the Ortho Whirlybird. Do not apply Temik 10G during the hot time of the day as perspiration will cause the Temik to be released if kernels land on your body. Wear a respirator mask, water-resistant clothing, goggles and rubber gloves during application and while filling or cleaning the equipment. After application, water the plants thoroughly and wash off any granules adhering to the foliage.

If the pests reappear, a second application may be necessary but should **not** be applied to potted plants within 4 weeks of sale. Do not plant food crops in soil previously treated for at least 1 year.

After application, wash hands and face before eating or smoking. After work, wash entire body with soap and water. Do not work with treated plants for 48 hours.

Ortho Whirlybird

WEED CONTROL

Cultivation and hand weeding are still the most practical methods for controlling weeds in greenhouses. However, the use of some of the methods mentioned below may be useful in reducing the amount of labor necessary to keep weeds under control.

Steam The use of steam to pasteurize soil will kill weeds and most weed seeds if the soil temperature can be held at 70°-80° C for 15 minutes. Weed seeds in the outer layer of soil which has been at a lower temperature, and weed seeds with hard seed coats may not be killed.

Soil Fumigation Metam (VAPAM), dazomet (MYLONE, BASAMID), and VORLEX break down in the soil and produce a gas which kills nematodes, most weed seeds, organisms which cause "damping off" and other plant diseases. They are, therefore, useful in treating seedbeds and potting soil. Methyl bromide is a liquid which forms a poisonous gas when released from its container. It should be used under a gas-proof cover (usually plastic). This chemical is so poisonous to man and livestock that only experienced operators should attempt to use it. The use of Methyl Bromide is subject to the Pesticides Act (1973) and Regulations which requires that a permit be obtained from the local Pesticides Control Officer or the Ontario Ministry of the Environment each time it is to be used.

Herbicides OMAF Publication 75, *Guide to Chemical Weed Control* contains information on herbicides which are registered for use in Ontario. The treatments listed in the publication are based on extensive field trials and observations on farms. **Unless specifically recommended, herbicides should not be used in cold frames or greenhouses.** Damage to plants has occurred when hormone-like herbicides (2, 4-D, mecoprop, etc.) have been used in or near greenhouses, when atrazine has been used to control weeds under benches, and when sulfallate (VEGEDEX) has been used in cold frames. A copy of Publication 75 is available at any OMAF office or from your Extension Horticulturist. The information on chemicals, safety precautions and calibration, care and use of sprayers should be read carefully.

Paraquat (GRAMOXONE), diquat (REGLONE) or a mixture of both may be used at 0.55-1.10 kg/ha (active), or 3 mL of product per litre per 100 m^2 to kill emerged weeds in walks and under benches. These chemicals act as a "chemical mower" and do not leave a harmful residue in the soil. If applied as a spray, the pressure should be kept low (35-125 kPa) as any spray droplets which land on greenhouse plants will damage the plants. A plastic dribble bar is available which can be fitted to a watering can. The spray produced is coarse and easy to control.

Activated Charcoal Where unwanted pesticide residues remain in soil, an application of activated charcoal can reduce the problem. The rate will vary depending on the type of chemical contaminant and its concentration. A usual range is 0.5 to 1.5 kg/100 m^2.

READ THE LABEL BEFORE USING

GROWTH REGULATORS

GROWTH REGULATORS

The use of growth regulators has become an important cultural tool in the production of greenhouse flower crops. They influence different processes in the plant such as root formation, flower induction, vegetative growth, etc. The following section will concentrate on limiting vegetative growth (height control).

1. Factors to Consider

(a) **Plant vigor** A healthy, vigorous plant is more apt to tolerate the stresses of growth regulators. For instance, the height reduction by growth retardants such as B-9, Cycocel and A-Rest will be more severe on weak plants. A-Rest applied to Easter Lilies with poor root development can cause undue loss of bottom leaves. A dehydrated plant will be more susceptible to growth regulator damage than a turgid plant. For all applications the root system of the plants should be well established.

(b) **Cultivar response** The growth habit of different cultivars may determine the concentration and the number of applications of growth regulators. A tall-growing pot mum such as the Annes would generally require a higher concentration of growth retardants than the shorter cultivars like the Mandalays.

(c) **Environment** Plants grown under low light may require less growth retardant than those under high light intensity. Therefore, the concentration may have to be adjusted accordingly for winter and summer production. A-Rest is reported to be ineffective on Easter Lilies if plants are lighted and given long days. Growth regulators should not be applied during the high heat period of the day (higher than 22%). Preference should be given to applications during the evening when the solution does not dry up rapidly or will be affected by the sun.

(d) **Stage of plant growth** Growth regulators are generally more effective when applied to young and vigorous plants. A-Rest applied to Easter Lilies that are less than 10 cm in height may reduce bud count, delay flowering and severely stunt plant growth. When applied too late, A-Rest will produce lilies with palm-tree effect. Early application may also affect the development of some (bottom) breaks on poinsettias and chrysanthemums. This is more pronounced with the higher rates or more effective growth regulators.

(e) **Dosage and coverage** It is extremely important that the correct concentration of the chemical be applied. Accurate measurement can only be made with proper weighing instruments and/or measuring containers. For Cycocel and B-9, recommendations are based on the concentration of the liquid solution being applied, whereas for A-Rest the recommendation is for drenching and expressed as total active ingredients per plant (per pot).

1 milligram of ingredient X per litre of water (1,000 g) = 1 ppm X
1 ppm = .0001% = 1 mg/L
10 ppm = .001% = 10 mg/L
100 ppm = .01% = 100 mg/L
1,000 ppm = 0.1% = 1,000 mg/L
10,000 ppm = 1.0% = 10,000 mg/L

Therefore, a 2,500 ppm B-9 concentration is a 0.25% solution containing 2,500 mg/L of active ingredient.

A-Rest contains 0.0264% active ingredient or, 264 ppm ancymidol. For 5 ppm, one needs a 1:53 dilution or 20 mL/L of water.

(f) Read the label. There are sometimes different formulations on the market and it is your responsibility to read the label and use the material accordingly. It may also give an indication about the need of a spreader sticker.

(g) Growth regulators should be stored in a similar manner as other pesticides namely in a *cool*, *dry* and *dark* site. Do not let the temperature drop below 0°C. Shelflife is at least two years. Some growth regulators may not be stable for a long time after being mixed with water. Therefore to prevent breakdown, mix just prior to use.

2. Methods of Application

(a) **Drench**.Some growth regulators are systemic within the vascular system (Cycocel and A-Rest). Drenching may provide a means of better distribution of the chemical within the plant and therefore more control. Treatment is precise but generally requires more labor. It is important that the roots be well-developed prior to application. This is critical for A-Rest drench on Easter Lilies. Make sure that plants are not under water stress, since injury can occur if plants are on the dry side. It may be wise to water the plants in late afternoon and apply the treatment the following morning. Apply adequate amounts of solution to wet the entire root mass. The following is the recommended drench volume for various pot sizes:

Pot size	Volume of drench solution
cm	mL
10	90
13	120
15	180
20	240
25	300

(b) **Spray** Application is less laborious; however, uniform coverage of the foliage is critical. Plants should be turgid to prevent foliage damage. Keep foliage dry for 12-24 hours after spraying to prevent washing off of the chemicals from the leaves. Most chemicals contain wetting agents; however, a spreader may be required in some cases to obtain more uniform distribution of the chemical on the foliage and decrease the possibility of leaf damage. A rate of 20 L of spray/100 m^2 will generally give good coverage. To prevent excessive wastage of the chemicals, arrange the plants as close as possible without undue crowding. It is **very important** that spraying equipment is operating properly. It is desirable to keep a separate sprayer for this job and clean the sprayer after each application to safeguard against unnecessary damage from other chemical residues.

Pot size	Volume of drench solution
cm	mL
5.5	1
10	3
12.5	6
15	10
20	20

3. Number of Applications

A **single** application is naturally the most economical as a drench or spray; however, it is a "one-shot" treatment and vulnerable to mistakes.

A **split** application using one-half the suggested concentration applied twice 1-2 weeks apart does allow for more flexibility and reduces the chances of damage to plants. It also allows time to monitor plant growth, and repeated applications can be made accordingly.

GROWTH REGULATOR RECOMMENDATIONS

PLANT	GROWTH REGULATOR	CONCENTRATION	METHOD OF APPLICATION
AZALEAS	B-Nine SP (85%) (height control)	2,500-3,500 ppm (0.25-0.35%)	spray
	Cycocel (11.8%)* (height control)	2,000 ppm (0.20%)	spray
BEDDING PLANTS	B-Nine SP (85%) (height control)	2,500-5,000 ppm (0.25-0.50%)	spray
CHRYSANTHEMUMS (pot mums)	B-Nine SP (85%) (height control)	2,500-5,000 ppm (0.25-0.50%)	spray
	A-Rest (0.0264% ancymidol) (height control)	2-8 ppm (0.5-0.25 mg/15 cm pot)	drench for 2 ppm (120 mL/15 cm pot)
CHRYSANTHEMUMS (cut mums)	B-Nine SP (85%) (height control)	2,500 ppm (0.25%)	spray the top one/third of the foliage
GERANIUM (Carefree)	Cycocel (11.8%)* (height control)	2,000-3,000 ppm (0.2-0.3%)	soil drench
HYDRANGEAS	B-Nine SP (85%) (height control during forcing)	2,500-5,000 ppm (0.25-0.50%)	spray to wet foliage
LILIES	A-Rest (0.0264% ancymidol) (height control)	0.25 mg/15 cm pot	drench 180 mL of 1.3 ppm solution/15 cm pot
POINSETTIAS	B-Nine SP (85%) (height control)	5,000-7,500 ppm (0.50-0.75%)	spray
	A-Rest (0.0264% ancymidol) (height control)	2-8 ppm (0.5-0.25 mg/15 cm pot)	drench
	Cycocel (11.8%)* (height control)	1,500-3,000 ppm (0.15-0.30%)	spray or drench

*) make adjustment in mixing rates when using Cycocel Extra.

FOR GREENHOUSE FLORICULTURE CROPS

MIXING RATES METRIC	TIME OF APPLICATION	COMMENTS
3.0-4.2 g/L of water	After last pinch when shoots are 2-5 cm long (6 weeks after pinching). Apply early morning.	Increases short day response and early bud formation. Don't let solution drip on medium.
20 mL/L of water	Apply during short day treatment twice, with 1-week interval.	Can produce medium-hard plants, slight chlorosis and/or uneven flowering. Also used to promote early flowering on some varieties.
3.0-6.0 g/L of water	2-4 weeks after transplanting when plants are 3-5 cm diameter. May be repeated 4 weeks later.	Good for most bedding plants but not effective on snapdragons, celosia, coleus, pansies, pelargonium (geranium), carnation, cleome, convolvulus and gomphrena.
3.0-6.0- g/L of water	Apply when shoots are 2-4 cm long. May be repeated 3 weeks later.	Use the low concentration to the pinched crops and the high concentration to the single stem pot mum. Spray to wet foliage.
for 2 ppm mix: 8 mL/L of water	Apply just as root system spreads over outside soil ball.	For 2 ppm dilute 1:128. Entire soil must receive uniform application. A-Rest contains a wetting agent.
3.0 g/L of water	Two days after dis-budding or 4 weeks after shade initiation.	Do not mix B-9 with any other pesticides.
For 2,500 ppm mix: 21 mL/L of water	3 weeks after transplanting.	May cause some marginal leafburn. Induces earlier flowering.
3.0 — 6.0- g/L of water	Apply first spray between 2 & 3 weeks (4-5 leaf stage); 2nd spray one week later.	Can apply after buds are visible if necessary.
for 1.3 ppm mix: 5 mL/L of water	Apply when lilies are 7-15 cm tall. Do not apply Jan. 23-Feb. 7, as bud count may be reduced.	Can also be used as a spray. Spray may affect flower bud count. Not very effective if bark medium is used.
6.0-9.0 g/L of water	Spray when shoots are approx. 5 cm tall.	Do not add any wetting agent. Late application may delay blooming.
for 2 ppm mix: 8 mL/L of water	Treat plant at pinch to 4 weeks after pinch, or 8 to 12 weeks before finishing.	Do not add a wetting agent. Use 125-150 mL of solution to a 15 cm tall.
13-25 mL/L of water	Apply when shoots are 2-4 cm tall.	Application later than Oct. 10 may delay flower development. Spraying twice with one-half the recommended concentration is more effective than once with the high concentration.

4. Estimating Final Plant Height

Floriculture researchers have found that the final height of Chrysanthemums and Poinsettias can be predicted. This finding can be very useful in determining the effectiveness of a growth retardant and whether additional applications are necessary. Four weeks following the start of short days, Chrysanthemum and Poinsettia reach approximately one-half of their final height at maturity. By measuring the plant height from pot rim 4 weeks following short days and doubling this height, you would have an estimation of final height. If at 4 weeks the doubling of the height gives an estimation of the final height that is still **too tall**, another application of growth retardant can be given on that day. This will cause a further retardation in growth, thus a more desirable plant will be produced. Growers should try this system on a trial basis to determine whether it can be incorporated into their cultural program as a growth-monitoring technique.

5. Directions for Mixing Chemicals

(a) READ THE LABEL.

(b) The final volume should include the growth regulator which is to be added. The first step is to add the chemical then make up to final volume with water. If the direction reads 60 mL B-9/L, first add 60 mL of B-9 in a suitable measuring container, then add water to the 1 L mark. **Do not add 60 mL B-9 to 1 L of water.** Remember that the final solution including B-9 should be 1 L.

(c) Don't add wetting agent (spreader) if the label informs that it is already present in the solution.

(d) Read the label to see if the material is sufficiently stable for storage after mixing. It is best to mix chemicals before each application to ensure proper activity of the chemical.

(e) Don't mix growth regulators with **any** chemicals. The application of growth regulators is too critical to warrant mixing with other chemicals. Don't take chances to save time. Take time to do the best job of mixing and applying growth regulators.

ACIDITY AND ALKALINITY

Soil pH The term pH represents the degree of acidity or alkalinity of a solution (or soil). It is measured on a scale of 0-14. A pH of 7 is neutral; values below 7 are called acid (sour), and those above are alkaline.

The pH is a very important characteristic of a soil as it influences the solubility and, thus, the availability of nutrients. Moreover, it influences indirectly the colonization of certain pathogens in the soil which may be harmful to plants.

Generally, a pH between 6.0 and 7.0 is an acceptable range for soil mixes or soil-grown crops. Azaleas and gardenias are exceptions to this rule while it is optional for hydrangeas and hyacinths. The pH of a soil can change due to many different reasons, e.g., continuous use of certain fertilizers, pH of irrigation water, type of soil amendments, etc. A regular check of soil pH, therefore, can be very helpful.

For soilless mixes with more than 50% organic material, the pH for optimal nutrient availability is between 5.0 and 6.0

Any correction of the soil pH can be best managed at the time of soil preparation prior to planting. Limestone (dolomitic or calcitic) is usually used to increase the pH to the desired level. For a bench crop (loamy soil) the following rule of thumb may be used. To increase the pH with 0.1 unit, use 4.8 kg of limestone per 100 m^2. For a soil with a higher clay content or a higher organic matter content the recommended amount can be increased by about 25%. Two to three weeks after application, the soil pH should be checked to see whether the desired pH level is attained. It may be noted that the finer the limestone, the quicker the reaction with the soil.

The rate of change is also affected by temperature, moisture and aeration conditions of the soil. Changes will occur most rapidly when soils or soilless media are warm, moist and well aerated.

The use of hydrated lime in greenhouses has some severe drawbacks as it reacts very quickly and actively. Proper distribution of the material throughout the soil mixture is difficult and the use of this material is very limited.

For potting mixtures, the amount of limestone to be added depends on the type and the ratio of the ingredients. Acidic are sphagnum peatmoss (pH 3.5 to 4.5) and bark (pH = 4.0) while alkaline materials are often the baked clay types such as Turface, Haydite and Crackpot or Sand. The amount of limestone to neutralize sphagnum peatmoss from a pH of 3.5 to 5.5 is about 6-7 kg per m^3 of loose peatmoss. The addition of clay additives with a high pH should reduce this rate of limestone. A check on the pH of the mix should be made after preparation, but before planting.

There are different methods to lower the pH in the growing mixture. Acid peat moss, ground sulfur, iron sulfate and/or aluminum sulfate can be used as an amendment to a bench crop. Rates of application according to Cornell recommendations are listed in the table below.

Materials	g/100 m^2 To Lower pH 1/2-1 Unit[1]	Rate of pH Change
Finely Ground Sulfur	2.5 kg	slow
Aluminum Sulfate	15 kg	rapid
Iron Sulfate	15 kg	moderate

[1] Rates are for light to medium soils. For heavier soils with more organic matter, increase rate by one third. The rates per m^3 of potting soils are one half the recommended rates from above.

Low calcium and magnesium levels are becoming apparent in many greenhouse soils that have been in production for many years. The reason is that water soluble fertilizers now in use lack calcium and magnesium because of the high phosphorus content. If the pH has dropped, the use of dolomitic limestone is recommended as a source of calcium and magnesium. However, if the pH has remained within the

desired range, the use of gypsum (calcium sulphate) at the rates of 10-50 kg/100m^2 will supply calcium and Epsom Salts (magnesium sulphate) at rates of 5-15 kg/100m^2 will supply magnesium.

Water pH The addition of an acid to the irrigation water on a continuous basis is possible, as well. Phosphoric acid (85%) is often used. Recommended additions vary between 6 and 18 mL per 100 L of water depending on the characteristics of the water. An exact level can be obtained by trial and error. Your Extension Horticulturist should be consulted if in doubt. The pH of the irrigation water should preferably not be below the 5.0 level.

Nitric acid and sulphuric acid can also be used but are more hazardous to use from a safety point of view as well as the amount of acid has to be added more accurately than phosphoric acid.

For making concentrates, ACID MUST BE ADDED TO WATER.

A safe, weak acid is ammonium dihydrogen phosphate. 50 gms per 100 L of irrigation water will lower the pH of most irrigation waters from 7.5 to 6.5-6.8.

PESTICIDE INJURY TO CROPS

Although greenhouse insecticides have been selected and formulated to avoid plant injury, damage can still occur under some conditions. No insecticides are safe on all plants under all conditions, although wettable powders are generally less injurious than liquid formulations. In many cases, a material may be safe when applied to dry foliage but can cause injury when used on wet foliage. Here is a list of possible hazards.

1. **Acti-Dione P.M.** may injure new growth on roses, especially during hot weather.
2. **Cygon** will injure many Chrysanthemum varieties.
3. **DDVP** (Vapona, dichlorvos) is injurious on some Chrysanthemum varieties, especially Shasta and Pink Champagne. Also damages some varieties of snapdragons.
4. **Diazinon** is not for use on Gardenias, Poinsettias, Hibiscuses, Stephanotis, Pileas and Hydrangeas.
5. **Dibrom** injures some ornamentals including some Chrysanthemum varieties.
6. **Dylox** damages some carnations, Chrysanthemums and Zinnia varieties. Insecticidal soaps will burn foliage and flowers under warm, sunny conditions.
7. **Lindane** injures Hydrangeas, Poinsettias.
8. **Malathion** should not be used on ferns, Petunias and Crassulas, orchids, sweetpeas, cucurbits, Saintpaulia, Gloxinia, Rieger Begonias, some carnation and rose varieties.
9. **Metaldehyde** has reportedly damaged Cattleya and Phalaenopsis orchids when applied as sprays and dusts.
10. **Meta-Systox R** damages lilies, Rieger Begonias and geraniums.
11. **Morestan** has damaged rose varieties.
12. **Nicotine** may injure lilies and some Chrysanthemum varieties. Do not use smoke on open blooms of snapdragons and geraniums.
13. **Parathion** may prove harmful to Gardenias, Hydrangeas, Crassulas, ferns, Kalanchoes, asters, Cyclamens, tender foliage plants, Rieger Begonias and succulents. May cause leaf drop on roses if used within 7 days of sulfur, particularly in the fall or winter.

CAUTION — Parathion may have a bleaching effect on the open blooms of all flower crops.

14. **Pentac** causes some foliage damage on Chrysanthemums. Do not apply to open blooms.
15. **Pirimor** should not be applied to Icecap, Goldcap and related varieties of Chrysanthemums.
16. **Resmethrin** should not be applied to open blooms of Shoesmith varieties of Chrysanthemums. Do not treat Red Calceolaria.
17. **Sevin** (carbaryl) should not be used on Boston Ivy or Virginia Creeper.
18. **Tedion** (tetradifon) may cause injury to some roses, especially White Butterfly and Cinderella.
19. **Thiodan** (endosulfan) may injure some geranium varieties. Emulsifiable concentrate has injured Bonnaffon Deluxe and some other Chrysanthemum varieties.

See also Compatibility of Pesticides on page 9.

MAJOR GREENHOUSE PESTS

Aphids

These insects are often referred to as plant lice. They are small with long legs and antennae, and have a pair of tube-like structures called cornicles projecting from the posterior end. Several species may occur in the greenhouse, each having a specific color pattern ranging from black, grey, red and yellow or green. Adult aphids may be winged or wingless. Aphids are found in colonies on new buds and under leaves near the veins. Female aphids give birth to living young and these offspring can reproduce with 7-10 days. One aphid can give birth to 60 to 100 young over a 20-day period. Populations can build up very rapidly. It is important to inspect new foliage continuously for the presence of aphids to prevent large infestations. Aphids pierce plant tissue with their mouthparts and suck out the sap, causing deformed leaves and flowers. They also produce a sticky substance called honeydew which allows the development of black, sooty mold fungus. Some aphids are capable of transmitting plant viruses which may result in yellowing or distorted leaf tissue. Fumigation may be more effective and less phytotoxic to plants when infestations occur in the blossom stage. Systemic insecticides applied as foliar sprays or as drenches and granules are highly effective and preferred by most growers.

Fungus Gnats

Fungus gnats or sciarid flies are becoming a serious problem because of the greater use of soilless mixes that have a high organic matter or peatmoss content. The grey-black colored adult fly is about 4 mm in length with long legs, thread-like antennae and large compound eyes which meet above the base of the antennae. The adult is a weak flier and is frequently observed resting on the media surface in the pot. Each female (lifespan of 10 days) lays between 150 and 170 oval, white eggs in the organic matter of the media. They hatch in 2 to 7 days, depending on temperature, to produce white larvae 4 to 6 mm long. The larvae have 12 abdominal segments and a shiny black head. They feed on young roots of plants and decaying organic matter. Root feeding by the larvae promotes various root rot organisms. The larvae spin pupal cases and remain immobile in the soil for 4-6 days, after which adult flies emerge. The sciarid becomes more active at warmer temperatures. The life cycle can be completed in 21 days at 24°C compared with 38 days at 16°C. Sanitation in the greenhouse as well as outside is very important. Soil drenches and granular pesticides will give effective control.

Chrysanthemum Leafminer

The serpentine leafminer, *Liriomyza trifoli*, is one of the major pests of greenhouse floriculture in Ontario. The adult leafminer fly is small (approx. 3 mm long) with black and yellow markings. Adults become active at sunrise; females feed on soft succulent chrysanthemum leaves by piercing the surface with their ovipositor and then lapping the liquid exuding from the leaf. After a pre-egg-laying period of 12-24 hours after emergence from pupae, female flies lay an average of 17 eggs per day, or approximately 250 eggs during their lifetime (approx. 30 days). Eggs are laid in about one out of seven leaf punctures ("stipples"). The optimal temperature for leafminer development is 30°C. At temperatures above or below 30°C, the egg production per female declines considerably. After 2-4 days, eggs hatch and larvae start feeding (mining) in the leaf tissue. The larvae mature in 4-7 days (temperature dependent) in the summer and then cut a hole in the leaf surface and drop to the soil. Within a few hours pupation takes place in the soil or on the soil surface and these pupae remain there for 7-10 days (temperature dependent) in the summer. From the pupae, a new generation of adult flies emerges. Of course, within any greenhouse there is a considerable overlapping of stages of the insect's life cycle.

Based on lab studies the complete life cycle (egg to adult) is as short as 14 days at 30°C and increases to 24 days at 20°C and 65 days at 14°C. It has been reported that at low soil temperatures (10-12°C) the pupae may remain in the soil for up to 90 days. This fact may

account for the winter survival of the leafminer around the inside perimeter of the greenhouse, even though no leafminers are evident. There is still no evidence that this insect can overwinter outdoors in Ontario.

More than 50 hosts other than chrysanthemum have been identified as alternate hosts for leafminer including many vegetables and many common weeds. Our recommended leafminer control strategy involves a wise use of: (1) Cultural controls (steamind, weed control, sanitation, etc.), (2) Population monitoring (using yellow sticky boards); and (3) Chemical controls. This insect's resistance to most insecticides is a major concern. Good pesticide coverage of the crop (2000 L per hectare) and rotation of pesticide classes is essential. There are no chemical controls for the egg or pupal stage of leafminer at present. The only effective treatments at present are systemic insecticides to kill larvae and contact sprays to kill adults.

Mealybugs

Two distinct groups of mealybugs may be found in greenhouses. The more commonly encountered **foliage-feeding mealy bugs** are white, wax-covered, sac-like insects with piercing mouthparts which remove plant sap and produce large amounts of honeydew. The females (1 to 3 mm long) lay large numbers of eggs in masses of wax. From these eggs hatch (in 5-10 days) active immature mealybugs called crawlers. These require 6 to 8 weeks to mature. Damage is caused by the removal of plant sap, the growth of black, sooty mold fungus on the honeydew and the unsightly appearance of the waxy secretions. Mealybugs are one of the most serious greenhouse pests because of the rapid spread of large numbers of crawlers and their ability to exist under bud scales and within leaf axils. Males, present in low numbers, are small, winged insects.

Occasionally, **root feeding** or **subterranean mealybugs** are found within masses of wax on the roots of wilting or yellowed plants. These insects are much like those described above except that they secrete less wax over their bodies. Again the crawler stage may spread to other plants through contaminated equipment or water leaching through pots. Most infestations result from introduced material that was contaminated. Inspect all plant materials entering the greenhouse carefully for the presence of mealybugs. Systemic granular and drench insecticides are the most effective for controlling these insects.

Mites

Mites are generally small organisms and, in contast to insects, are wingless with oval bodies and 8 short legs. The adult females lay microscopic, spherical eggs which produce the immature nymphs. They have piercing-sucking mouthparts which remove sap from plant tissue giving leaves a dried, whitish appearance or cause new growth to be distorted. Two of the more common species will be mentioned here.

Cyclamen mite

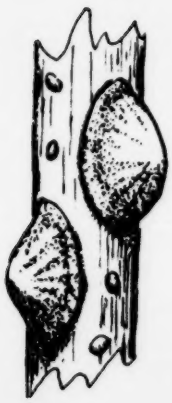
The cyclamen mite is microscopic in size, being no more than .25 mm in length. It cannot be seen without magnification. The hind pair of legs of the female are thread-like while those of the male are pincer-like. The pale brown female mite deposits approximately 100 eggs, 80% of them female, around the crown of the plant, or along the midrib of unfolded leaves. The mites develop through the six-legged larval stage and quiescent nymphal stage with eight legs similar to the two-spotted mite. The life cycle from egg to adult requires about two weeks but varies depending on temperatures. Usually distorted leaf tissue and/or small blasted or twisted flower buds and flowers are the first observed symptoms. The foliage often will show purplish areas. The cyclamen mites feed around the crown of plants or in the flower buds. Cyclamen is usually the most seriously injured but it is becoming more prevalent in the foliage industry as plant materials are imported from many parts of the world.

Two-Spotted Spider mite

Several species of spider mites occur in the greenhouse. However, the two-spotted spider mite is the most destructive, attacking a wide range of floricultural crops. The eight-legged female adult mite is approximately .50 mm in length with a rounded abdomen. The adults range from pale yellow to orange to brown in color. The male can be distinguished from the female by its smaller, narrower body and pointed abdomen. Close examination of the undersurface of the leaves will show the mites to be very tiny moving dots. The two dark spots on the body are the food contents showing through the transparent body. After mating, each female mite begins laying approximately six pearly-white eggs per day. Over an average life time, 100 or more eggs are laid by a female on the undersurface of the foliage. The newly-hatched mites pass through the typical six-legged larval, protonymph and detonymph stages. The deutonymph is an immobile resting stage and hence a very difficult target for miticides. The life cycle from egg to adult ranges from 23 days at 15°C to ***only*** *7 days at 27°C.* Development is rapid under hot, dry conditions.

Two-spotted mites usually develop on the undersides of foliage. All active stages feed through sucking mouthparts by piercing the lower epidermis. The feeding injury is characterized by the entire leaf appearing light-colored or "stippling" on the upper leaf surface. In addition to direct feeding injury, spider mites produce webbing over the foliage and flowers. If infestations are allowed to proceed without control measures, plants may be killed. Mite populations seem to "explode" at certain times of the year because the life cycle varies considerably with temperature. Other factors including relative humidity, plant nutrition and cultivar are also important.

Scale Insects



Scales are minute, wingless insects, up to 3 mm in length and have piercing-sucking mouthparts and an oval or hemispherical body shape. They secrete a characteristic waxy or scale-like covering over their bodies. The males, which are rare, do have wings. Most individuals are females which may lay hundreds of eggs under their scale. When these hatch, small individuals called crawlers migrate to new feeding sites where they remain mobile. Damage is caused by the removal of sap from the plants causing yellowing and wilting. A number of species have been identified on greenhouse ornamentals in recent years, mainly due to the increased amount of foliar stock being imported from tropical areas. Many of the newer introductions of ferns, palms and ivy plants are quite susceptible to scale infestations. Some of the more common species are described.

Ivy scale and greedy scale These scales are similar in appearance, being pale and circular in shape with a prominent yellowish nipple in the centre. Both attack a wide variety of greenhouse plants such as ivy, palms, *Ficus* and *Fuchsia.*

Fern scale The shield of this scale resembles an oyster shell and is brown with a lighter terminal nipple. It is usually found on ferns and other foliage.

Brown soft scale Female scales are flat, brown and pliable. They have a wide host range and produce large amounts of honeydew which allows development of black, sooty mold fungus.

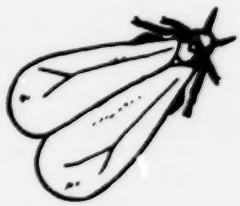
Hemispherical scale The scale covering of this species is very convex, brown and shiny. Ferns are a favorite host.

Like mealybugs, scales can be initially controlled by eliminating any introduction of infested material. Granular systemic materials and fog solutions are effective in controlling established infestations.

Thrips

Several thrip species are found in the greenhouse including flower thrips, onion thrips, chrysanthemum thrips and greenhouse thrips. Thrips are tiny, slender, agile insects about 1.5 to 3 mm in length when fully developed. Adults are usually dark brown or yellow while the young thrips are usually white or yellow with red eyes. The rasping sucking mouthparts rasp off the epidermal layer of leaves or flowers and then suck out the plant juices. The injury is observed as white streaked areas on the leaves or translucent spots on the flower petals. They also deposit specks of black fecal material on the leaf surfaces. The life cycle of all thrips is similar. The female adult lays her tiny white eggs inside the leaf tissues. In 5 to 7 days, the eggs hatch and form pale white nymphs which also feed on the leaves and petals. They pass through several nymphal stages and a short pupal stage (in soil) before entering the adult stage. Adults can live as long as 7 weeks. A new generation may occur every 20 to 35 days depending on temperatures. Thorough coverage of the host with insecticides is essential as thrips are small enough to hide in leaf axils or flower heads. All stages can be found throughout the year in greenhouses. The presence of thrips can be confirmed by tapping buds or flowers over a sheet of white paper.

Whiteflies



One of the most serious pests of greenhouses, whiteflies are found on a wide variety of plants and are difficult to control. Adults are small, winged insects, white in color about 1.5 mm in length. Eggs are laid on the undersides of leaves and appear as a ring of small, black specks. A female may lay up to 400 eggs and live as long as 2 months. The nymphs which hatch in 5 to 10 days are flat and sac-like and move over the plant before settling down. Their piercing mouthparts allow them to remove sap from the plant and they produce large amounts of honeydew which allows black, sooty mold fungus to grow. New leaf tissue is preferred by the nymphs. There they can be found feeding on the undersides of the leaves. Old pupal skins and adults may be found on lower leaves which may have symptoms of wilt. The life cycle can be completed in 4 or 5 weeks. Granular systemic insecticides and the synthetic pyrethroids as foliar sprays have been shown to be effective in controlling this pest. It has proven to be a very persistent pest and has become resistant to pesticides which were formerly effective. Judicious use of currently recommended insecticides by alternation of materials and less frequent applications may help to prevent a rapid development of this resistance problem in your greenhouse.

OCCASIONAL GREENHOUSE PESTS

Ants

These are easily recognized by their elbowed antennae and narrow waists. They may be as little as 1½ mm or as large as 6 mm in length. In greenhouses where insect feeding has produced honeydew, ants may be a problem as they are attracted to this sweet substance. Ant trails or nests should be located in or near the greenhouse and treated with chlordane as directed on the label.

Armyworms

Occasionally, adult moths of the armyworm may enter greenhouses and deposit eggs on plant material. The caterpillars which hatch are dark in color with longitudinal stripes. They are voracious feeders and may do considerable harm to foliage before being noticed. Infestations may be brought under control using insecticides recommended for caterpillars.

Black Vine Weevil

Weevils or snout beetles are characterized by a hard body with a snout and elbowed antennae. This species is dull brown to black, about 9 mm in length with fine ridges along its back. Its larvae are legless grubs, white in color with a reddish-brown head and found among roots of various bedding plants. Adults actively lay eggs in June with the larvae feeding on the roots for the rest of the season. The larvae will attack a wide range of plants including roses, geraniums, ferns, gardenias and rhododendrons. Although the adult does not fly, it is able to move to new plantings easily and control measures should be directed against it during late May and June. Inspection of the roots of material introduced to the greenhouse may also prevent an infestation. Add Cabbage Loper (E-4).

Cutworms

Adult cutworm moths are attracted to lights in a greenhouse during spring and early summer and may deposit eggs in the soil at the base of plants. The caterpillar which hatches actively feeds at night on young seedlings or transplants and burrows into the soil during the day. It is usually dull brown or grey in color with longitudinal stripes and has the habit of curling into a tight coil when disturbed. Insecticides which are effective against caterpillars will control this pest. Weedy areas near greenhouses may also harbor cutworms and provide a constant source of reinfestation.

Grasshoppers

Grasshoppers are easily recognizable and are occasional invaders of greenhouses. They will feed on almost any vegetation and, in large numbers, can destroy plants. Grass and weeds near greenhouses may allow an infestation of these insects to occur, usually in late summer and fall. Foliar sprays such as Sevin, malathion, Cygon and diazinon are effective. Add Greenhouse Leaf Tier (E-5).

Leafhoppers

Leafhoppers are small, light-colored insects, 3 mm or less in length. They have piercing mouthparts with which they remove plant sap and cause yellowed and mottled leaves. Some species are able to transmit virus-like disease-causing organisms. Infestations in flower crops, such as chrysanthemums, can be detected by these small insects jumping and flying when the foliage is disturbed. Foliar sprays or fog solutions are an effective means of control.

Midges

These small, orange, delicate flies lay eggs on stems or leaves of the chrysanthemum. The small larvae which hatch burrow into the tissue, cause a swelling of stems and produce elongate galls on leaves. Control should be directed against the adults and early stage larvae. The adults are effectively controlled with fumigants or fogging solutions.

Plume Moths

Plume moth adults are only rarely found in greenhouses. They may be attracted by lights or their eggs or larvae brought in with plant material. The small, brown moth is usually found at rest with its wings outstretched in a "T" position. The caterpillars are cream colored with a brown head and may feed within webbed foliage or bore into the stems of plants such as geraniums. Fumigation is used for control.

Slugs and Snails

Slugs are slimy, dark-grey, soft-bodied creatures, varying in length from 1.3 to 10 cm which glide over the plants, leaving a slimy trail. They eat the foliage of most greenhouse plants, shredding the leaves, and may completely destroy a plant. Slugs are nocturnal, and will hide under any cover during the day.

Snails are similar in habit and appearance to slugs except that a snail carries its shell around at all times. The shells vary in color and markings, and may be 1.3 to 5 cm in diameter. Snails are particularly injurious to seedlings and eat holes in flowers and leaves on many plants, leaving them slimy and tattered. Control of these organisms is obtained with baited pesticides combining bran bait with metaldehyde.

Sowbugs/Pillbugs

Sowbugs and pillbugs have grey, flattened, oval bodies up to 13 mm in length and have 7 pairs of legs. They are scavengers, but may feed on roots and tender parts of plants causing damage to seedlings. They feed at night and hide during the day, preferring dark, moist areas with an abundance of organic matter. Soil sterilization and elimination of decaying plant material and moist areas will aid greatly in preventing any buildup of these organisms.

Springtails

These are tiny, wingless insects less than 5 mm long and white or grey in color. They are usually found on the surface of moist soil in pots or within the soil. They have a springtime apparatus at the end of their abdomen which allows them to spring into the air. Springtails feed on decaying organic matter or on algae and fungi. They occasionally are numerous enough to be a nuisance. Soil drenches of diazinon will control them.

Stalk Borers

One species of stalk borer, the European corn borer, is an occasional pest in greenhouses. The light tan moth is attracted to lights in late summer and may lay egg masses on foliage after entering the house. The caterpillars which hatch bore into the stems and cause damage to many plants, such as chrysanthemums and roses. Control measures should be instituted before the small larvae are able to enter the plant tissue. Screening vents may prevent the moths from entering the house.

Symphylids

They have slender, long, white bodies with 12 pairs of legs and long antennae. Found in moist soil which contains decaying organic matter, they eat tiny holes in roots and root hairs. Injured roots become stubby and plant takes on a stunted appearance. Symphylids move in the soil and attack a wide range of plants.

Tarnished Plant Bug

These bugs, about 6 mm in length, are yellow-brown in color and have piercing mouthparts. They and their green nymphs can be serious pests of composites such as chrysanthemums. Eggs are inserted into plant tissue with the small nymphs completing their life cycle in about 4 weeks. They damage new growth causing distortion of foliage and dead and distorted flower buds. They are most active in the late fall and may gain access to the greenhouse from surrounding weedy areas. Foliar sprays and fumigants are effective control measures.

Vertebrate Pests

Rats and mice may be very destructive in the greenhouse. They feed on almost any food source and can cause damage by gnawing and burrowing. The Norway rat and field and house mice are the most common vertebrate inhabitants of greenhouses. Rodenticides, as baits, are available containing such chemicals as chlorophacinone, diphacinone, warfarin, and zinc phosphide. Care should be taken to see that these baits are placed in covered stations where pets cannot get at them.

TREATMENT OF COMMON PROBLEMS

Snails and slugs Mesurol 2% Bait — 500 gm/100m^2
Metaldehyde — follow label directions.

Symphalids Lindane 25% WP — 150 g in water to cover 100 m^2

Leafhoppers, Grasshoppers Sevin 50% WP — 2.0 kg/1,000 L

Ants Chlordane 800 EC 70-140 mL/100m^2

Root Nematodes

Plants attacked by root nematodes become stunted and unthrifty. Leaves of some crops, such as roses, may be of abnormal color, suggesting a mineral deficiency. Infested plants are also prone to wilting. Loss of productivity may be the result of a reduction in the number, length and quality of flower stems (or the unsightly appearance of potted plants).

Root-lesion nematode, *Pratylenchus penetrans* (Cobb) Native to Ontario soils, this can attack a wide range of greenhouse floral crops, particularly roses. All stages are threadlike and invisible to the naked eye. Invades the outer layers of young roots, causing small brown-to-black elliptical-shaped lesions which merge to discolor the roots and cause their death.

Northern root-knot nematode, *Meloidogyne hapla* (Chitwood) Native to Ontario soils and can attack a great number of floral crops, particularly roses, African violets and geraniums. Early larval stages are threadlike and invisible, while later stages and adults are peanut- to pearl-shaped and just visible when dissected from roots. This nematode invades roots and settles down to cause swellings, knots or galls, and excessive root proliferation. Infested roots do not necessarily become discolored unless attacked by bacteria and fungi.

Dagger nematode, *Xiphinema diversicaudatum* (Micoletzky). Not native to Ontario, but introduced into greenhouses on plant stocks. Only roses are attacked. The nematode survives in the root crotches of the understock. One of the largest nematodes attacking plants, this 6 mm long, threadlike roundworm can, with care, be seen on the roots. It feeds on young roots from the soil, causing galls not unlike root-knot galls but somewhat larger. These galls are actually curved swellings in the root-tip area, accentuated with the necrosis and shriveling of the roots above the galls.

Control of Root Nematodes

Preplant Soil Fumigation

— See section on soil fumigation and steaming (page 8-10).

Postplant Soil Treatment

Dasanit* 15% G: 3.25 kg/100m^2 (330 g/m^3)

New rose bushes should be established at least 3 months before application.

Foliar Nematodes

Foliar symptoms caused by nematodes, unfortunately, are common to a number of disease and deficiency problems and do not necessarily indicate the presence of nematodes. Furthermore, because of the nematodes' soil habitat and small size, specific laboratory and microscopic techniques are necessary to confirm their presence and number.** There are no effective nematicides registered for use.

Strawberry bud nematode, *Aphelenchoides fragariae* (Ritzema Bos) Not native to Ontario, but introduced on plant stock, this nematode is primarily a problem on Begonia but it can attack other greenhouse ornamentals. Invisible and threadlike, it moves in moisture films on stems and leaves. It enters leaves through the stomata and feeds in the inner layers of the leaf, causing small brown spots wih water-soaked margins to form on the underside of leaves, which then enlarge and merge, turn dark brown and become visible on the upper surface. Finally, the entire leaf is affected.

Chrysanthemum nematode, *Aphelenchoides ritzema-bosi* (Shwartz) Not native to Ontario, this nematode is also introduced on plant stock. It is almost identical to the Strawberry bud nematode and moves and infests plants in the same manner. Dark brown spots on the underside of leaves are the early symptoms, then the veins become discolored and infested leaves turn brown or black, forming distinct wedge-shaped areas between the veins. Finally the leaves dry, shrivel, and hang down along the stems.

*There is a possibility that these chemicals are phytotoxic to a plant species or cultivar; therefore, test the chemical on a few plants before using in a major treatment.

**Diagnostic assistance in the control of nematodes is essential and may be obtained at no charge from the Agriculture Canada Research Station, Box 185, Vineland Station, Ontario L0R 2E0.

MAJOR GREENHOUSE DISEASES

FUNGUS DISEASES

Botrytis blight (Grey mold) This fungus disease may affect bulbs, stems, leaves and flowers. High humidity caused by crowding the plants, poor ventilation and leaving old leaves and flowers on the plants or soil surface all encourage an outbreak of Botrytis. Symptoms vary from host to host. If the air is very humid the organism develops a fuzzy grey growth on infected plant parts.

Leaf spots, flower spots and blights Spores of the fungi that cause these diseases are wind-borne or splashed about when watering. The leaves must be wet for infection to take place.

Powdery mildew May be recognized by the white powdery growth of the fungus on the leaves, stems and floral parts. The growth is sparse at first but may eventually cover the entire upper surface of the leaves. On some plants such as roses, the fungal growth may become felt-like. Affected rose leaves frequently develop a reddish discoloration. Generally, the powdery mildew fungus that affects one crop will not affect another. Spores of the fungus are spread by air currents and require high humidity for spore germination and infection of the host.

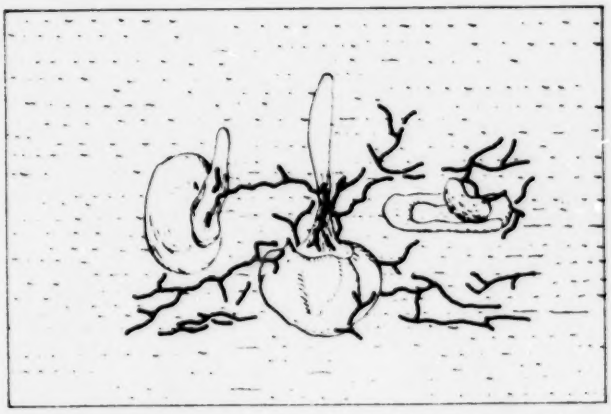
Wilt *Fusarium* and *Verticillium* fungi interfere with the water-conducting tissue in the plant. Leaves may wilt, become yellowish and eventually turn brown. Plant growth and bloom production are reduced. Plants may be killed. The fungi persist in the soil and gain entrance through the roots. Most common means of infection would be propagation of infected stock or planting susceptible plants in infested soil.

Damping-off of seedlings Wet soil, poor sanitation, poor ventilation, high humidity and thick strands of seedling are ideal conditions for damping-off fungi. There are 3 types of damping-off that can cause major problems in bedding plants.

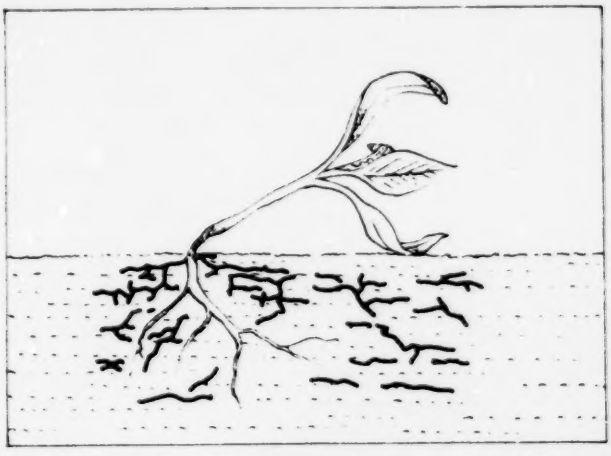
Rust Rust fungi attacking one host do not attack another. They may be identified by the masses of orange-to-dark-red or brown spores that are seen when pustules on leaves or stems break open. Rust may occur on carnation, Chrysanthemum, snapdragon and others. Rust spores are spread by air currents and by splashing water. They require water on the leaf to germinate and infect the plant, and may travel long distances in infected cuttings.

Crown and root rots All the fungi described below are soil inhabitants. *Pythium* and *Phytophthora* fungi cause a rotting of the roots and crowns of many plants. The lower part of the leaf and petioles of such plants as gloxinia and African violet and stems of other plants have a water-soaked appearance. Eventually the entire plant will rot off at the ground level.

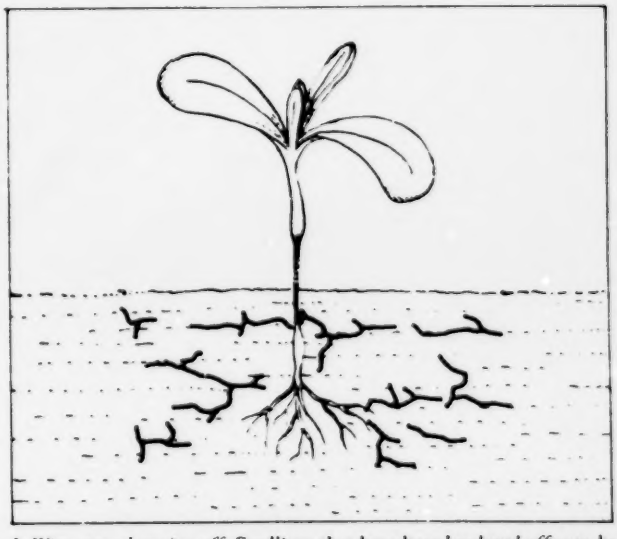
Rhizoctonia and *Fusarium* fungi cause a brown cankering of the below-ground stem and roots of infected plants. *Thielaviopsis* causes a severe rotting of the roots of infected plants. The affected areas are more black in color than brown.



1. Preemergence damping-off. The seeds are killed before germination, or soon after. The young plants never emerge from the soil. This loss is often blamed on poor seed.



2. Postemergence damping-off. Most growers are familiar with this stage. The stem is invaded near the soil surface. The seedling wilts, the stem collapses and the plant topples over. Other variations of postemergence damping-off include top rot or top damping-off, and root rot.



3. Wire-stem damping-off. Seedlings that have been hardened off may be attacked by damping-off organisms. Stems are partially girdled, discolored and wire-like in appearance; hence the name wire stem. Infected plants are stunted and eventually die.

VIRUS DISEASES

Viruses are disease-causing agents that multiply only within living plant cells. They tend to spread throughout the host plant. Depending on the virus, they are spread by sucking insects, such as aphids and leafhoppers or by tools, handling, etc. Some viruses are spread with cuttings. Vein banding, flecking, ring-spots, mosaic (irregular areas of dark and light green on the leaf), or growth abnormalities may develop in the leaves, depending on the particular virus. Some viruses cause stunting.

BACTERIAL DISEASES

Control of bacterial diseases is very difficult, but fortunately they are not as common as fungus diseases. Bacterial infections may appear as wilts, stem and root rots, leaf spots, galls and fasciation of plant parts. Good cultural practices and extreme care in sterilization procedures will reduce the chance of bacterial infection. Fixed copper sprays are a reasonable control for bacterial diseases *but* phytotoxicity may be a problem.

	Botrytis	Fusarium	Leaf Spots[1]	Powdery Mildew	Rusts	Pythium	Phytophthora	Rhizoctonia	Sclerotinia	Thielaviopsis
Acti-dione PM				X	X					
Benlate	?	?	X	?				X	X	X
Botran	X									
Captan	X		X			R				
Daconil 2787	X	X	X	X						
Exotherm Termil	X									
Ferbam			X		X					
Funginex				X	X					
HRC Liquids systemic					X[2]					
Karathane				X						
Lesan						X	X			
Meltatox				X						
No Damp								X		
Quintozene								X	X	
Rovral	X							X	R	
Sulphur			X	X						
Truban						X	X			
Vitavax Captan						X		X		
Zineb, Maneb			X		R					

[1] *check label for specific leaf spot control*
[2] *Carnation rust only*
R *Indicates possible resistance*
? *indicates possible resistance*
X *indicates effective control of disease*

PEST AND DISEASE CONTROL BY CROP

PROBLEM	RECOMMENDATION	FOR 1000 L	OTHER
	AFRICAN VIOLET (Saintpaulia)		
Aphid	Thiodan 4 EC or Thiodan 50% WP	1.25 L 1.0 kg	
	DDVP Smoke Fumigator or DDVP Fog Solution		1/300 m^3 35 mL/100 m^3
	Dibrom Insecticide		20 mL/100 m^3
	Sulfotep Smoke Fumigator or Sulfotep Fog Solution		1/300 m^3 35 mL/100 m^3
	Enstar 65 EC	500-750 mL	
	Insecticidal Soap	20-25L	
Cyclamen Mite	Kelthane 18.5% EC or Kelthane 35% WP Thiodan 50% WP or Thiodan 4 EC	1.25 L 750 g 1.0 kg 1.25 L	35 mL/100 m^3
Fungus Gnat	Malathion 50 EC	1.0 L	
	Lindane Smoke Fumigator		1/300 m^3
Mealybug	DDVP Smoke Fumigator		1/300 m^3
	Lorsban 25% WP	3.84 kg	
	Diazinon 50% EC or Diazinon 50% WP	0.63-1.25 L 1.0-1.5 kg	
	Lindane 25 WP	1.0 kg	
	Dibrom Insecticide		20 mL/100 m^3
	Insecticidal Soap	20-25L	
Thrips	Diazinon 50% EC or Diazinon 50% WP	0.63-1.25 L 1.0-1.5 kg	
	Lindane Smoke Fumigator or Lindane 25 WP	 1.0 kg	1/300 m^3
Twospotted Spider Mite	Tedion V-18 Smoke Fumigator		1/300 m^3
	Insecticidal Soap Kelthane 18.5% EC or Kelthane 35% WP or Kelthane Fog Solution	20-25L 1.25 L 750 g	 35 mL/100 m^3
	Vendex 50% WP Plictran 50% WP	0.5-1.0 kg 250-375 g	

PROBLEM	RECOMMENDATION	FOR 1000 L	OTHER
Botrytis	Benlate 50% WP + Manzate 200	500 g 2.5 kg	
	Captan 50% WP	2.0 kg	
	Captan 80% WP	1.5 kg	
	Rovral 50% WP	1.0 kg	
	Exotherm Termil Smoke Fumigator		1/300 m^3
Crown Rot	Lesan 35% WP	450-900 g Apply to 100 m^2	
	Truban 30% WP	175-625 g	
Powdery Mildew	Benlate 50% WP + Manzate 200	500 g 2.5 kg	
	AZALEA		
Aphid	Thiodan 4 EC or Thiodan 50 WP	1.25 L 1.0 kg	
	DDVP Smoke Fumigator or DDVP Fog Solution		1/300 m^3 35 mL/100 m^3
	Dibrom Insecticide		20 mL/100 m^3
	Enstar 65 EC	500-750 mL	
	Sulfotep Smoke Fumigator or Sulfotep Fog Solution		1/300 m^3 35 mL/100 m^3
	Insecticidal Soap	20-25L	
Cyclamen Mite	Kelthane 18.5% EC or Kelthane 35% WP	1.25 L 750 g	
	Thiodan 50% WP or Thiodan 4 EC	1.0 kg 1.25 L	
Leafroller	Dipel	0.63-1.25 kg	
Thrips	Diazinon 50 EC or Diazinon 50 WP	0.63-1.25 L 1.0-1.5 kg	
	Lindane Smoke Fumigator or Lindane 25% WP	1.0 kg	1/300 m^3
	Malathion 50 EC	1.88 L	
	DDVP Smoke Fumigator or DDVP Fog Solution		1/300 m^3 35 mL/100 m^3

PROBLEM	RECOMMENDATION	FOR 1000 L	OTHER
Twospotted Spider Mite	Kelthane 18.5% EC or Kelthane 35% WP	1.25 L 750 g	
	Pentac Aqua Flow	650 mL	
	or Pentac 50% WP or Pentac Fog Solution	625 g	 35 mL/100 m^3
	Vendex 50% WP Plictran 50% WP	1.0 kg 250-375 g	
	Insecticidal Soap	20-25L	
Whitefly	Thiodan 4 EC or Thiodan 50 WP	1.25 L 1.0 kg	
	DDVP Smoke Fumigator or DDVP Fog Solution		1/300 m^3 35 mL/100 m^3
	Dibrom Insecticide		20 mL/100 m^3
	Sulfotep Smoke Fumigator or Sulfotep Fog Solution		1/300 m^3 35 mL/100 m^3
	Enstar 65 EC	500-750 mL	
	Pounce EC	275 mL	
	Insecticidal Soap	20-25L	
Petal Blight	Benlate 50% WP + Manzate 200	500 g 2.5 kg	
	BEDDING PLANTS		
Aphid	Pirimor 50% WP	500 g	
	Nicotine Smoke Fumigator		1/300 m^3
	Thiodan 50% WP or Thiodan 4 EC	1.0 kg 1.25 L	
	DDVP Smoke Fumigator or DDVP Fog Solution		1/300 m^3 35 mL/100 m^3
	Sulfotep Smoke Fumigator or Sulfotep Fog Solution		1/300 m^3 35 mL/100 m^3
	Dibrom Insecticide		20 mL/100 m^3
	Enstar 65 EC	500-750 mL	
	Insecticidal Soap	20-25L	
Fungus Gnat	Lindane Smoke Fumigator or Lindane Fog Solution		1/300 m^3 35 mL/100 m^3

PROBLEM	RECOMMENDATION	FOR 1000 L	OTHER
Twospotted Spider Mite	Pentac Aqua Flow or Pentac 50 WP or Pentac Fog Solution	650 mL 625 kg	 35 mL/100 m^3
	Kelthane 18.5% EC or Kelthane 35% WP	1.25 L 750 g	
	DDVP Smoke Fumigator or DDVP Fog Solution		1/300 m^3 35 mL/100 m^3
	Tedion V-18 Smoke Fumigator		1/300 m^3
	Vendex 50% WP Plictran 50% WP	0.5-1.0 kg 250-375 g	
	Insecticidal Soap	20-25L	
Whitefly	Ambush 50 EC	200 mL	
	Enstar 65 EC	500-750 mL	
	Sulfotep Smoke Fumigator or Sulfotep Fog Solution		1/300 m^3 35 mL/100 m^3
	Pounce EC	275 mL	
	Insecticidal Soap	20-25L	
	Parathion Smoke Fumigator		1/300 m^3
	DDVP Smoke Fumigator or DDVP Fog Solution		1/300 m^3 35 mL/100 m^3
	Thiodan 50 WP or Thiodan 4 EC	1.0 kg 1.25 L	
	Dibrom Insecticide		20 mL/100 m^3
Botrytis	Exotherm Termil Smoke Fumigator		1/300 m^3
	Benlate 50% WP + Manzate 200	500 g 2.5 g	
	Captan 50% WP or Captan 80% WP	2.0 kg 1.5 kg	
	Rovral 50% WP	1 kg	
Damping-Off	Truban 30% WP	250-375 g	
	Lesan 35% WP	600-750 g Apply to 100 m^2	
	Quintozene 20% WP or Quintozene 75% WP		4-6 kg/100 m^2 1.0-1.25 kg/100 m^2
	Vitavax-Captan 30% WP	250 g	
	No-Damp	10 L	
	Rovral 50% WP		2 g/5 L/m^2
Powdery Mildew	Benlate 50% WP + Manzate 200	500 g 2.5 kg	

PROBLEM	RECOMMENDATION	FOR 1000 L	OTHER
	BEGONIA (Rieger)		
Aphid	Thiodan 50% WP or Thiodan 4 EC	1.0 kg 1.25 L	
	DDVP Smoke Fumigator or DDVP Fog Solution		1/300 m^3 35 mL/100 m^3
	Sulfotep Smoke Fumigator or Sulfotep Fog Solution		1/300 m^3 35 mL/100 m^3
	Insecticidal Soap	20-25L	
	Enstar 65 EC	500-750 mL	
Mealybug	Malathion 50% EC	1.88 L	
	DDVP Smoke Fumigator or DDVP Fog Solution		1/300 m^3 35 mL/100 m^3
	Diazinon 50% WP or Diazinon 50 EC	1.0-1.5 kg 0.63-1.25 L	
	Lorsban 25% WP	3.84 kg	
	Dibrom Insecticide		20 mL/100 m^3
	Insecticidal Soap	20-25L	
Thrips	Diazinon 50% WP or Diazinon 50% EC	1.0-1.5 kg 0.63-1.25 L	
	Lindane Smoke Fumigator or Lindane Fog Solution or Lindane 25% WP	 1.0 kg	1/300 m^3 35 mL/100 m^3
	Malathion 50% EC	1.88 L	
	DDVP Smoke Fumigator or DDVP Fog Solution		1/300 m^3 35 mL/100 m^3
Twospotted Spider Mite	Kelthane 18.5% EC or Kelthane 35% WP	1.25 L 750 g	
	Tedion V-18 Smoke Fumigator		1/300 m^3
	Vendex 50% WP Plictran 50% WP	0.5-1.0 kg 250-375 g	
	Insecticidal Soap	20-25L	
Whitefly	Ambush	200 mL	
	Thiodan 50% WP or Thiodan 4 EC	1.0 kg 1.25 L	
	DDVP Smoke Fumigator or DDVP Fog Solution		1/300 m^3 35 mL/100 m^3
	Sulfotep Smoke Fumigator or Sulfotep Fog Solution		1/300 m^3 35 mL/100 m^3
	Pounce EC	275 mL	

PROBLEM	RECOMMENDATION	FOR 1000 L	OTHER
	Enstar 65 EC	500-750 mL	
	Insecticidal Soap	20-25L	
Botrytis	Benlate 50% WP + Manzate 200	500 g 2.5 kg	
	Botran 75% WP	925 g	
	Captan 50% WP or Captan 80% WP	2.0 kg 1.5 kg	
	Rovral 50% WP	1.0 kg	
Root Rot (Cuttings)	Lesan 35% WP	0.50-1.0 kg Apply to 100 m^2	
	Truban 30% WP	175-625 g	
	Captan 50% WP or Captan 80% WP	2.0 kg 1.5 kg	
	Vitavax-Captan 30% WP	250 g	
Powdery Mildew	Benlate 50% WP + Manzate 200	500 g 2.5 kg	
	BULB CROPS		
Tulip Bulb Aphid	Lindane 25% WP or Lindane Smoke Fumigator or Lindane Fog Solution	1.0 kg	 1/300 m^3 35 mL/100 m^3
	DDVP Smoke Fumigator or DDVP Fog Solution		1/300 m^3 35 mL/100 m^3
	Thiodan 50% WP or Thiodan 4 EC	1.0 kg 1.25 L	
	Dibrom Insecticide		20 mL/100 m^3
Botrytis	Benlate 50% WP + Manzate 200	500 g 2.5 kg	
	Captan 50% WP or Captan 80% WP	2.0 kg 1.5 kg	
Blight	Benlate 50% WP + Manzate 200	500 g 2.5 kg	
Crown Rot	Truban 30% WP	175-625 g	
	CALCEOLARIA		
Aphid	DDVP Smoke Fumigator or DDVP Fog Solution		1/300 m^3 35 mL/100 m^3

PROBLEM	RECOMMENDATION	FOR 1000 L	OTHER
	Lindane 25% WP or Lindane Smoke Fumigator or Lindane Fog Solution	1.0 kg	 1/300 m^3 35 mL/100 m^3
	Enstar 65 EC	500-750 mL	
	Insecticidal Soap	20-25L	
Fungus Gnat	Malathion 50 EC	1.88 L	
	Lindane 25% WP or Lindane Smoke Fumigator or Lindane Fog Solution	1.0 kg	 1/300 m^3 35 mL/100 m^3
Thrips	Lindane 25% WP or Lindane Smoke Fumigator or Lindane Fog Solution	1.0 kg	 1/300 m^3 35 mL/100 m^3
Twospotted Spider Mite	Vendex 50% WP Plictran 50% WP	0.5-1.0 kg 250-375 g	
	Insecticidal Soap	20-25L	
Whitefly	Enstar 65 EC	500-750 mL	
	Insecticidal Soap	20-25L	
	Thiodan 50% WP or Thiodan 4 EC	1.0 kg 1.25 L	
	DDVP Smoke Fumigator or DDVP Fog Solution		1/300 m^3 35 mL/100 m^3
	Dibrom Insecticide Pounce EC	 275 mL	20 mL/100 m^3
Botrytis	Benlate 50% WP + Manzate 200	500 g 2.5 kg	
	Captan 50% WP or Captan 80% WP	2.0 kg 1.5 kg	
Powdery Mildew	Benlate 50% WP + Manzate 200	500 g 2.5 kg	
		CARNATION	
Aphid	Diazinon 50% EC or Diazinon 50% WP	0.63-1.25 L 1.0-1.5 kg	
	Nicotine Smoke Fumigator		1/300 m^3
	DDVP Smoke Fumigator or DDVP Fog Solution		1/300 m^3 (under 20°C) 35 mL/100 m^3
	Dibrom Insecticide		20 mL/100 m^3
	Sulfotep Smoke Fumigator or Sulfotep Fog Solution		1/300 m^3 35 mL/100 m^3
	Enstar 65 EC	500-750 mL	
	Insecticidal Soap	20-25L	

PROBLEM	RECOMMENDATION	FOR 1000 L	OTHER
Thrips	Lindane 25% WP	1.0 kg	
	or Lindane Smoke Fumigator		1/300 m^3
	or Lindane Fog Solution		35 mL/100 m^3
	Diazinon 50% WP	1.0-1.25 kg	
	or Diazinon 50% EC	0.63-1.25 L	
	or Diazinon Fog Solution		35 mL/100 m^3
Twospotted Spider Mite	Pentac Aqua Flow	650 mL	
	or Pentac 50% WP	625 g	
	Kelthane 18.5% EC	1.25 L	
	or Kelthane 35% WP	750 g	
	Vendex 50% WP	0.5-1.0 kg	
	Plictran 50% WP	250-375 g	
	Insecticidal Soap	20-25L	
	DDVP Smoke Fumigator		1/300 m^3
	or DDVP Fog Solution		35 mL/100 m^3
Alternaria Leaf Spot	Captan 7.5% Dust		
	or Captan 50% WP	2.0 kg	
	or Captan 80% WP	1.5 kg	
Botrytis	Exotherm Termil Smoke Fumigator		1/300 m^3
Fusarium Stem Rot	Benlate 50% WP	500 g	
	+ Manzate 200	2.5 kg	
Greasy Blotch	Captan 7.5% Dust		
	or Captan 50% WP	2.0 kg	
Leaf Spot	Ferbam 76% WP	1.0-1.5 kg	
Rhizoctonia Stem Rot	Quintozene 20% Dust		4 kg/100 m^2
	or Quintozene 75% WP		1.25 kg/100 m^2
	Vitavax-Captan 30% WP	350 g	
Rust	H.R.C.		20 PPM (As a soil drench. Follow label directions)
	CHRYSANTHEMUM		
Aphid	Pirimor 50% WP	500 g	
	Diazinon 50% WP	1.0-1.5 kg	
	or Diazinon 50 EC	0.63-1.25 L	
	or Diazinon Fog Solution		35 mL/100 m^3
	Nicotine Smoke Fumigator		1/300 m^3
	DDVP Smoke Fumigator		1/300 m^3
	or DDVP Fog Solution		35 mL/100 m^3

PROBLEM	RECOMMENDATION	FOR 1000 L	OTHER
	Meta-Systox R 25% EC	1.88 L	
	Sulfotep Smoke Fumigator or Sulfotep Fog Solution		1/300 m^3 35 mL/100 m^3
	[2]Temik 10G (see note page 10)		550 g/100 m^2
	Enstar 65 EC	500-750 mL	
	Insecticidal Soap	20-25L	
Caterpillar	Thuricide HPC	5 L	
	Dipel	1.0-1.25 kg	
Cyclamen Mite	Kelthane 18.5% EC or Kelthane 35% WP	1.25 L 750 g	
	Thiodan 50% WP or Thiodan 4 EC	1.0 kg 1.25 L	
Leafhopper	Sevin 50% WP	2.0 kg	
	Lindane 25% WP or Lindane Smoke Fumigator or Lindane Fog Solution	1.0 kg	1/300 m^3 35 mL/100 m^3
	Malathion 50% EC	1.88 L	
Leaf Miner	Diazinon 50% WP or Diazinon 50 EC	1.0-1.5 kg 0.63-1.25 L	
	[2]Temik 10G		550 g/100 m^2 (see note page XX)
	Ambush 50 EC	200 mL	
Leaftier	Diazinon 50% WP or Diazinon 50% EC	1.0-1.5 kg 0.63-1.25 L	
Midge	Parathion Smoke Fumigator		1/300 m^3
	Lindane Smoke Fumigator or Lindane Fog Solution		1/300 m^3 35 mL/100 m^3
	Sulfotep Smoke Fumigator or Sulfotep Fog Solution		1/300 m^3 35 mL/100 m^3

[2] *Minimum period before reentry is 48 hours.*

PROBLEM	RECOMMENDATION	FOR 1000 L	OTHER
Leaf Spot	Captan 7.5% Dust or Captan 50% WP	 2.0 kg	
Powdery Mildew	Benlate 50% WP + Manzate 200	500 g 2.5 kg	
Tarnished Plant Bug	Lindane 25% WP or Lindane Smoke Fumigator or Lindane Fog Solution	1.0 kg	 1/300 m^3 35 mL/100 m^3
	Malathion 50% EC	1.88 L	
Thrips	Diazinon 50% WP or Diazinon 50 EC	1.0-1.5 kg 0.63-1.25 L	
	Lindane 25% WP or Lindane Smoke Fumigator or Lindane Fog Solution	1.0 kg	 1/300 m^3 35 mL/100 m^3
Twospotted Spider Mite	Pentac Aqua Flow or Pentac 50% WP	650 g 625 g	
	Tedion V-18 Smoke Fumigator		1/300 m^3
	Kelthane 18.5% EC or Kelthane 35% WP	1.25 L 750 g	
	Meta-Systox R 25% EC	1.88 L	
	[2]Temik 10G		550 g/100 m^2 (see note page 10)
	Vendex 50% WP	0.5-1.0 kg	
	Plictran 50% WP	250-375 g	
	Insecticidal Soap	20-25L	
Whitefly	Ambush	200 mL	
	Enstar 65 EC	500-750 mL	
	Insecticidal Soap	20-25L	
	Sulfotep Smoke Fumigator or Sulfotep Fog Solution or Dibrom Insecticide		1/300 m^3 35 mL/100 m^3 20 mL/100 m^3
	DDVP Smoke Fumigator or DDVP Fog Solution		1/300 m^3 35 mL/100 m^3
	[2]Temik 10G		550 g/100 m^2 (see note page 10)
	Pounce EC	275 mL	
Ascochyta Ray Blight	Benlate 50% WP + Manzate 200	500 g 2.5 kg	
	Zineb 3.9% Dust		

PROBLEM	RECOMMENDATION	FOR 1000 L	OTHER
Botrytis	Benlate 50% WP	625 g	
	Exotherm Termil Smoke Fumigator		1/300 m^3
	Botran 75% WP	925 g	
	Rovral 50% WP	1.0 kg	
Root Rot	Lesan 35% WP	450-900 g Apply to 100 m^2	
	Truban 30% WP	175-625 g	
	Vitavax-Captan 30% WP	350 g	
		CINERARIA	
Aphid	Thiodan 50% WP or Thiodan 4 EC	1.0 kg 1.25 L	
	DDVP Smoke Fumigator or DDVP Fog Solution		1/300 m^3 35 mL/100 m^3
	Sulfotep Smoke Fumigator or Sulfotep Fog Solution		1/300 m^3 35 mL/100 m^3
	Enstar 65 EC	500-750 mL	
	Insecticidal Soap	20-25L	
Twospotted Spider Mite	Kelthane 18.5% EC or Kelthane 35% WP	1.25 L 750 g	
	Insecticidal Soap	20-25L	
	Tedion V-18 Smoke Fumigator		1/300 m^3
	Vendex 50% WP Plictran 50% WP	0.5-1.0 kg 250-375 g	
Whitefly	Thiodan 50 WP or Thiodan 4 EC	1.0 kg 1.25 L	
	DDVP Smoke Fumigator or DDVP Fog Solution		1/300 m^3 35 mL/100 m^3
	Dibrom Insecticide		20 mL/100 m^3
	Sulfotep Smoke Fumigator or Sulfotep Fog Solution		1/300 m^3 35 mL/100 m^3
	Pounce EC	275 mL	
	Enstar 65 EC	500-750 mL	
	Insecticidal Soap	20-25L	
Botrytis	Benlate 50% WP + Manzate 200	500 g 2.5 kg	
	Botran 75% WP	925 g	

PROBLEM	RECOMMENDATION	FOR 1000 L	OTHER
	Captan 7.5% Dust or Captan 50% WP or Captan 80% WP	 2.0 kg 1.5 kg	
	Rovral 50% WP	1.0 kg	
Powdery Mildew	Benlate 50% WP + Manzate 200	500 g 2.5 kg	
Stem Rot	Lesan 35% WP	450-900 g Apply to 100 m^2	
	Vitavax-Captan 30% WP	250 g	
	CYCLAMEN		
Aphid	Nicotine Smoke Fumigator		1/300 m^3
	Thiodan 50% WP or Thiodan 4 EC	1.0 kg 1.25 L	
	DDVP Smoke Fumigator or DDVP Fog Solution		1/300 m^3 35 mL/100 m^3
	Sulfotep Smoke Fumigator or Sulfotep Fog Solution		1/300 m^3 35 mL/100 m^3
	Enstar 65 EC	500-750 mL	
	Insecticidal Soap	20-25L	
Cyclamen Mite	Kelthane 18.5% EC or Kelthane 35% WP	1.25 L 750 g	
	Thiodan 50% WP or Thiodan 4 EC	1.0 kg 1.25 L	
Fungus Gnat	Diazinon 50% WP or Diazinon 50% EC	0.75-1.10 kg 0.63-1.25 L	
	Malathion 50% EC	1.88 L	
	Lindane 25% WP or Lindane Smoke Fumigator or Lindane Fog Solution	1.0 kg	 1/300 m^3 35 mL/100 m^3
Twospotted Spider Mite	Vendex 50% WP Plictran 50% WP	0.5-1.0 kg 250-375 g	
	Insecticidal Soap	20-25L	
Botrytis	Benlate 50% WP + Manzate 200	500 g 2.5 kg	
	Botran 75% WP	925 g	
	Captan 7.5% Dust or Captan 50% WP or Captan 80% WP	 2.0 kg 1.5 kg	
	Rovral 50% WP	1.0 kg	

PROBLEM	RECOMMENDATION	FOR 1000 L	OTHER
	Exotherm Termil Smoke Fumigator		1/300 m^3
Fusarium Rust Rot	Benlate 50% WP + Manzate 200	500 g 2.5 kg	
	EXACUM		
Twospotted Spider Mite	Pentac Aqua Flow	650 ml	
Botrytis	Benlate 50% WP + Manzate 200	500 g 2.5 kg	
	Rovral 50% WP	1.0 kg	
Fusarium Root and Stem Rot	Benlate 50 WP + Manzate 200	500 g	

FOLIAGE PLANTS

NOTE:

Due to the diversity of foliage plants and the lack of factual information on plant damage, these recommendations are for **TRIAL USE ONLY.**

Aphid	Pirimor 50% WP	500 g	
	Malathion 50 EC	1.88 L	
	Thiodan 50% WP or Thiodan 4 EC	1.0 kg 1.25 L	
	DDVP Smoke Fumigator or DDVP Fog Solution		1/300 m^3 35 mL/100 m^3
	Enstar 65 EC	500-750 mL	
	Sulfotep Smoke Fumigator or Sulfotep Fog Solution		1/300 m^3 35 mL/100 m^3
	Dibrom Insecticide		20 mL/100 m^3
Brown Soft Scale	Malathion 50% EC	1.88 L	
	Sulfotep Smoke Fumigator or Sulfotep Fog Solution		1/300 m^3 35 mL/100 m^3
	Insecticidal Soap	20-25L	
Cyclamen Mite	Kelthane 18.5% EC or Kelthane 35% WP	1.25 L 750 g	

PROBLEM	RECOMMENDATION	FOR 1000 L	OTHER
Mealybug	Lorsban 25% WP	3.84 kg	
	Malathion 50% EC	1.88 L	
	DDVP Smoke Fumigator or DDVP Fog Solution		1/300 m^3 35 mL/100 m^3
	Diazinon 50% WP or Diazinon 50% EC	0.75-1.10 kg 0.63-1.25 L	
	Lindane 25% WP or Lindane Smoke Fumigator or Lindane Fog Solution	1.0 kg	 1/300 m^3 35 mL/100 m^3
	Dibrom Insecticide		20 mL/100 m^3
Twospotted Spider Mite	Pentac Aqua Flow or Pentac 50% WP or Pentac Fog Solution	650 g 625 g	 35 mL/100 m^3
	Kelthane 35% WP or Kelthane 18.5% EC or Kelthane Fog Solution	750 mL 1.25 L	 35 mL/100 m^3
	Vendex 50% WP	0.5-1.0 kg	
	Plictran 50% WP	250-375 g	
Whitefly	Ambush	200 mL	
	Pounce EC	275 mL	
	Enstar 65 EC	500-750 mL	
	Insecticidal Soap	20-25L	
Root Rot (Cuttings)	Captan 7.5% Dust or Captan 50% WP or Captan 80% WP	 2.0 kg 1.5 kg	
	Lesan 35	450-900 g Apply to 100 m^2	
	Truban 30% WP	175-625 g	
	Benlate 50% WP + Manzate 200	500 g 2.5 kg	
	Vitavax-Captan 30% WP	250 g	
Botrytis	Rovral 50% WP	1.0 kg	
		GERANIUM	
Aphid	DDVP Smoke Fumigator or DDVP Fog Solution		1/300 m^3 35 mL/100 m^3
	Pirimor 50% WP	500 g	
	Nicotine Smoke Fumigator		1/300 m^3
	Sulfotep Smoke Fumigator or Sulfotep Fog Solution		1/300 m^3 35 mL/100 m^3

PROBLEM	RECOMMENDATION	FOR 1000 L	OTHER
	Enstar 65 EC	500-750 mL	
	Insecticidal Soap	20-25L	
Fungus Gnat	Diazinon 50% WP or Diazinon 50% EC	1.0-1.5 kg 0.63-1.25 L	
	Lindane 25% WP or Lindane Smoke Fumigator or Lindane Fog Solution	1.0 kg	 1/300 m³ 35 mL/100 m³
Mealybug	Diazinon 50% WP or Diazinon 50% EC	1.0-1.5 kg 0.63-1.25 L	
	Lorsban 25% WP	3.84 kg	
	Malathion 50% EC	1.88 L	
	Dibrom Insecticide		20 ml /100 m³
Plume Moth	DDVP Smoke Fumigator or DDVP Fog Solution		1/300 m³ 35 mL/100 m³
Twospotted Spider Mite	Kelthane 18.5% EC or Kelthane 35% WP	1.25 L 750 g	
	Insecticidal Soap	20-25L	
	Vendex 50% WP	0.5-1.0 kg	
	Plictran 50% WP	250-375 g	
Whitefly	Ambush	200 mL	
	Thiodan 50% WP or Thiodan 4 EC	1.0 kg 1.25 L	
	Enstar 65 EC	500-750 mL	
	Insecticidal Soap	20-25L	
	Sulfotep Smoke Fumigator or Sulfotep Fog Solution		1/300 m³ 35 mL/100 m³
	Dibrom Insecticide		10 mL/100 m³
	Pounce EC	275 mL	
Botrytis	Benlate 50% WP + Manzate 200	500 g 2.5 kg	
	Botran 75% WP	925 g	
	Exotherm Termil Smoke Fumigator		1/300 m³
	Captan 7.5% Dust or Captan 50% WP or Captan 80% WP	 2.0 kg 1.5 kg	
	Rovral 50% WP	1.0 kg	

PROBLEM	RECOMMENDATION	FOR 1000 L	OTHER
		GERBERA	
Twospotted Spider Mite	Pentac Aqua Flow	650 mL	
	Kelthane 35% WP	750 g	
	or Kelthane 18.5% EC	1.25 L	
Thrip	Lindane 25% WP	1.0 kg	
	or Lindane Smoke Fumigator		1/300m³
	or Lindane Fog Solution		35 mL/100m³
	Diazinon 50% WP	1.0-1.25 kg	
	or Diazinon 50% EC	0.63-1.25 L	
	or Diazinon Fog Solution		35mL/100m³
Whitefly	Insecticidal Soap	20-25L	
Phytophthora Crown Rot	Lesan 35% WP	450-900 Apply to 100 m²	
		GLOXINIA	
Aphid	Thiodan 50% WP	1.0 kg	
	or Thiodan 4 EC	1.25 L	
	DDVP Smoke Fumigator		1/300 m³
	or DDVP Fog Solution		35 mL/100 m³
	Dibrom Insecticide		10 mL/100 m³
	Sulfotep Smoke Fumigator		1/300 m³
	or Sulfotep Fog Solution		35 mL/100 m³
	Enstar 65 EC	500-750 mL	
	Insecticidal Soap	20-25L	
Thrips	Diazinon 50% WP	1.0-1.5 kg	
	or Diazinon 50% EC	0.63-1.25 L	
	Lindane 25% WP	1.0 kg	
	or Lindane Smoke Fumigator		1/300 m³
	or Lindane Fog Solution		35 mL/100 m³
Twospotted Spider Mite	Kelthane 18.5% EC	1.25 L	
	or Kelthane 35% WP	750 g	
	Insecticidal Soap	20-25L	
	Vendex 50% WP	0.5-1.0 kg	
	Plictran 50% WP	250-375 g	
Root, Stem, Crown and Tuber Rot	Lesan 35% WP	450-900 g Apply to 100 m²	
	Truban 30% WP	175-625 g	
	Vitavax-Captan 30% WP	250 g	

PROBLEM	RECOMMENDATION	FOR 1000 L	OTHER
Botrytis	Rovral 50% WP	1.0 kg	
	Exotherm Termil Smoke Fumigator		1/300 m^3
		GYPSOPHILA	
Twospotted Spider Mite	Pentac Aqua Flow	650 mL	
	Kelthane 35% WP	750 g	
	or Kelthane 18.5% EC	1.25 L	
Thrips	Diazinon 50% WP	1.0-1.5 kg	
	or Diazinon 50% EC	0.63-1.25L	
	Lindane 25% WP	1.0 kg	
	or Lindane Smoke Fumigator		1/300 m^3
	or Lindane Fog Solution		35mL/100m^3
		HYDRANGEA	
Aphid	Malathion 50% WP	2.0 kg	
	Thiodan 50% WP	1.0 kg	
	or Thiodan 4 EC	1.25 L	
	DDVP Smoke Fumigator		1/300 m^3
	or DDVP Fog Solution		35 mL/100 m^3
	Dibrom Insecticide		20 mL/100 m^3
	Sulfotep Smoke Fumigator		1/300 m^3
	or Sulfotep Fog Solution		35 mL/100 m^3
	Enstar 65 EC	500-750 mL	
	Insecticidal Soap	20-25L	
Twospotted Spider Mite	Kelthane 18.5 EC	1.25 L	
	or Kelthane 35% WP	750 g	
	Thiodan 50% WP	1.0 kg	
	or Thiodan 4 EC	1.25 L	
	Vendex 50% WP	0.5-1.0 kg	
	Plictran 50% WP	250-375 g	
	Enstar 65 EC	500-750 mL	
	Insecticidal Soap	20-25L	
Botrytis	Benlate 50% WP	500 g	
	+ Manzate 200	2.5 kg	
	Captan 7.5% Dust		
	or Captan 50% WP	2.0 kg	
	or Captan 80% WP	1.5 kg	
	Rovral 50% WP	1.0 kg	
	Exotherm Termil Smoke Fumigator		1/300 m^3

PROBLEM	RECOMMENDATION	FOR 1000 L	OTHER
Powdery Mildew	Benlate 50% WP + Manzate 200	500 g 2.5 kg	
Root Rot	Lesan 35% WP	450-900 g Apply to 100 m^2	
	Vitavax-Captan 30% WP	250 g	
		LILY (Easter)	
Aphid	DDVP Smoke Fumigator or DDVP Fog Solution		1/300 m^3 35 mL/100 m^3
	Thiodan 50% WP or Thiodan 4 EC	1.0 kg 1.25 L	
	Sulfotep Smoke Fumigator or Sulfotep Fog Solution		1/300 m^3 35 mL/100 m^3
	Enstar 65 EC	500-750 mL	
	Insecticidal Soap	20-25L	
Fungus Gnat	Diazinon 50% WP or Diazinon 50% EC	1.0-1.5 kg 0.63-1.25 L	
	Lindane Smoke Fumigator or Lindane Fog Solution		1/300 m^3 35 mL/100 m^3
Twospotted Spider Mite	Vendex 50% WP Plictran 50% WP	0.5-1.0 kg 250-375 g	
	Insecticidal Soap	20-25L	
Botrytis	Benlate 50% WP + Manzate 200	500 g 2.5 kg	
	Exotherm Termil Smoke Fumigator		1/300 m^3
	Rovral 50% WP	1.0 kg	
Root Rot	Lesan 35 WP	450-900 g Apply to 100 m^2	
	Truban 30% WP	175-625 g	
	Vitavax-Captan 30% WP	250 g	
		POINSETTIA	
Brown Soft Scale	Sulfotep Smoke Fumigator or Sulfotep Fog Solution		1/300 m^3 35 mL/100 m^3
	Malathion 50% WP	2.0 kg	
	Insecticidal Soap	20-25L	

PROBLEM	RECOMMENDATION	FOR 1000 L	OTHER
Fungus Gnat	Diazinon 50% WP or Diazinon 50% EC	1.0-1.5 kg 0.63-1.25 L	
	Lindane Smoke Fumigator or Lindane Fog Solution		1/300 m^3 35 mL/100 m^3
Mealybug	Lorsban 25% WP	3.84 kg	
	Malathion 50% EC	1.88 L	
	DDVP Smoke Fumigator or DDVP Fog Solution		1/300 m^3 35 mL/100 m^3
	Lindane 25% WP	1.0 kg	
	Parathion Smoke Fumigator		1/300 m^3
	Dibrom Insecticide		20 mL/100 m^3
Twospotted Spider Mite	Kelthane 18.5% EC or Kelthane 35% WP	1.25 L 750 g	
	Insecticidal Soap	20-25L	
	Pentac Aqua Flow or Pentac 50% WP or Pentac Fog Solution	650 mL 625 g	 35 mL/100 m^3
[2]Temik 10 G			575 g/100 m^2 (see note page 10)
	Vendex 50% WP	0.5-1.0 kg	
	Plictran 50% WP	250-375 g	
Whitefly	Ambush	200 mL	
	DDVP Smoke Fumigator or DDVP Fog Solution		1/300 m^3 35 mL/100 m^3
	Thiodan 50% WP or Thiodan 4 EC	1.0 kg 1.25 L	
	Enstar 65 EC	500-750 mL	
	Insecticidal Soap	20-25L	
	Sulfotep Smoke Fumigator or Sulfotep Fog Solution		1/300 m^3 35 mL/100 m^3
	[2]Temik 10 G		550 g/100 m^2 (see note page 10)
	Pounce EC	275 mL	
Botrytis	Exotherm Termil Smoke Fumigator		1/300 m^3
	Rovral 50% WP	1.0 kg	
	Botran 75% WP	925 g	

PROBLEM	RECOMMENDATION	FOR 1000 L	OTHER
Rhizoctonia Stem Rot	Quintozene 20% Dust		4 kg/100 m^2
	or Quintozene 75% WP		1.0-1.25 kg/100 m^2
	Benlate 50% WP	500 g	
	+ Manzate 200	2.5 kg	
Root Rot	Lesan 35% WP	450-900 g Apply to 100 m^2	
	Quintozene 20% Dust		6 kg/100 m^2
	or Quintozene 75% WP		0.98-2.73 kg/100 m^2
	Truban 30% WP	175-625 g	
	Benlate 50% WP	500 g	
	+ Manzate 200	2.5 kg	
	Vitavax-Captan 30% WP	250 g	

* *Minimum period before reentry is 48 hours.*

ROSE

Aphid	Pirimor 50% WP	500 g	
	DDVP Smoke Fumigator		1/300 m^3
	or DDVP Fog Solution		35 mL/100 m^3
	Thiodan 50% WP	1.0 kg	
	or Thiodan 4 EC	1.25 L	
	Sulfotep Smoke Fumigator		1/300 m^3
	or Sulfotep Fog Solution		35 mL/100 m^3
	Nicotine Smoke Fumigator		1/300 m^3
	Orthene 75% SP	850 g	
	Enstar 65 EC	500-750 mL	
	Insecticidal Soap	20-25L	
Brown Soft Scale	Malathion 50% EC	1.88 L	
	Sulfotep Smoke Fumigator		1/300 m^3
	or Sulfotep Fog Solution		35 mL/100 m^3
	Insecticidal Soap	20-25L	
Leafroller	Dipel	1.0-1.25 kg	
	Thuricide HPC	5 L	
	Orthene 75% SP	850 g	
Midge	Orthene 75% SP	850 g	
	Parathion Smoke Fumigator		1/300 m^3
	Sulfotep Smoke Fumigator		1/300 m^3
	or Sulfotep Fog Solution		35 mL/100 m^3

PROBLEM	RECOMMENDATION	FOR 1000 L	OTHER
	Diazinon 50% WP or Diazinon 50% EC	1.0-1.5 kg (soil drench) 1.25 L	
Thrips	Diazinon 50% WP or Diazinon 50% EC	1.0-1.5 kg 1.25 L	
Twospotted Spider Mite	Pentac Aqua Flow or Pentac 50% WP	650 mL 625 g	
	Kelthane 18.5% EC or Kelthane 35% WP	1.25 L 750 g	
	Vendex 50% WP	0.5-1.0 kg	
	Plictran 50% WP	250-375 g	
	Insecticidal Soap	20-25L	
Whitefly	Ambush	200 mL	
	Enstar 65 EC	500-750 mL	
	Insecticidal Soap	20-25L	
	Sulfotep Smoke Fumigator or Sulfotep Fog Solution		1/300 m^3 35 mL/100 m^3
	Thiodan 50% WP or Thiodan 4 EC	1.0 kg 1.25 L	
	Orthene 75% SP	850 g	
	Pounce EC	275 mL	
Black Spot	Benlate 50% WP + Manzate 200	500 g 2.5 kg	
	Captan 7.5% Dust or Captan 50% WP or Captan 80% WP	 2.0 kg 1.5 kg	
	Zineb 3.9% Dust		
Powdery Mildew	Meltatox 40% EC Acti-Dione P.M.	2.5 L 3.13 kg	
	Benlate 50% WP + Manzate 200	 2.5 kg	
Botrytis	Rovral 50% WP	1.0 kg	
		SNAPDRAGON	
Aphid	Pirimor 50% WP	500 g	
	Nicotine Smoke Fumigator		1/300 m^3
	DDVP Smoke Fumigator or DDVP Fog Solution		1/300 m^3 35 mL/100 m^3
	Dibrom Insecticide		10 mL/100 m^3
	Sulfotep Smoke Fumigator or Sulfotep Fog Solution		1/300 m^3 35 mL/100 m3

PROBLEM	RECOMMENDATION	FOR 1000 L	OTHER
	Enstar 65 EC	500-750 mL	
	Insecticidal Soap	20-25L	
Cyclamen Mite	Kelthane 18.5% EC or Kelthane 35% WP	1.25 L 750 g	
	Thiodan 50% WP or Thiodan 4 EC	1.0 kg 1.25 L	
Thrips	Diazinon 50% WP or Diazinon 50% EC	1.0-1.5 kg 0.63-1.25 L	
	Lindane Smoke Fumigator or Lindane Fog Solution		1/300 m^3 35 mL/100 m^3
Twospotted Spider Mite	Pentac Aqua Flow or Pentac 50% WP	650 mL 625 g	
	Insecticidal Soap	20-25L	
	Kelthane 18.5% EC or Kelthane 35% WP	1.25 L 750 g	
	Vendex 50% WP	0.5-1.0 kg	
	Plictran 50% WP	250-375 g	
Whitefly	Thiodan 50% WP or Thiodan 4 EC	1.0 kg 1.25 L	
	DDVP Smoke Fumigator or DDVP Fog Solution		1/300 m^3 35 mL/100 m^3
	Dibrom Insecticide		10 mL/100 m^3
	Sulfotep Smoke Fumigator or Sulfotep Fog Solution		1/300 m^3 35 mL/100 m^3
	Enstar 65 EC	500-750 mL	
	Insecticidal Soap	20-25L	
Botrytis	Benlate 50% WP + Manzate 200	500 g 2.5 kg	
	Exotherm Termil Smoke Fumigator		1/300 m^3
	Captan 7.5% Dust or Captan 50% WP or Captan 80% WP	 2.0 kg 1.5 kg	
	Rovral 50% WP	1.0 kg	
Powdery Mildew	Benlate 50% WP + Manzate 200	500 g 2.5 kg	
Stem Rot	Lesan 35% WP	450-900 g Apply to 100 m^2	
	Truban 30% WP	175-625 g	

THE METRIC SYSTEM

Linear Measures (length)

10 millimetres (mm) = 1 centimetre (cm)
100 centimetres (cm) = 1 metre (m)
1000 metres = 1 kilometre (km)

Square Measures (area)

100 m x 100 m = 10,000 m^2 = 1 hectare (ha)
100 ha = 1 square kilometre (km^2)

Cubic Measures (volume)

Dry Measure

1000 cubic millimetres (mm^3) = 1 cubic centimetre (cm^3)
1,000,000 cm^3 = 1 cubic metre (m^3)

Liquid Measure

1000 millilitres (mL) = 1 litre (L)
100 L = 1 hectolitre (hL)

Weight Measures

1000 milligrams (mg) = 1 gram (g)
1000 g = 1 kilogram (kg)
1000 kg = 1 tonne (t)
1 mg/kg = 1 part per million (ppm)

Weight – Volume Equivalents

(1.00 kg) 1000 grams = 1 litre (1.00 L)
(0.50 kg) 500 g = 500 mL (0.50 L)
(0.10 kg) 100 g = 100 mL (0.10 L)
(0.01 kg) 10 g = 10 mL (0.01 L)
(0.001 kg) 1 g = 1 mL (0.001 L)

Dry – Liquid Equivalents

1 cm^3 = 1 mL
1 m^3 = 1000 L

CONVERSION TABLES — METRIC TO IMPERIAL
(approximate)

Length

1 millimetre (mm)	=	0.04 inch
1 centimetre (cm)	=	0.40 inch
1 decimetre (dm)	=	4.0 inches
1 metre (m)	=	40.0 inches
1 metre (m)	=	3.28 feet
1 metre (m)	=	1.09 yards
1 kilometre	=	0.62 mile

Volume (liquid)

1 millilitre (mL)	=	0.035 fluid ounce
1 litre (L)	=	35 fluid ounces
1 litre (L)	=	1.76 pints
1 litre (L)	=	0.88 quart
1 litre (L)	=	0.22 gallon (Imperial)
1 litre (L)	=	0.26 gallon (U.S.)
1 hectolitre (hL)	=	26.42 gallons (U.S.)
1 hectolitre (hL)	=	22.00 gallons (Imperial)
1,000 litres	=	219 gallons (Imperial)

Weight

1 gram (g)	=	0.035 ounce
1 kilogram (kg)	=	2.2 pounds
1 tonne (t)	=	1.10 short tons
1 tonne (t)	=	2205 pounds

Pressure

1 kilopascal (kPa) = 0.145 pounds/square inch

Area

1 square centimetre (cm^2)	=	0.16 square inch
1 square metre (m^2)	=	10.77 square feet
1 square metre (m^2)	=	1.20 square yards
1 square kilometre (km^2)	=	0.39 square mile
1 hectare (ha)	=	107,636 square feet
1 hectare (ha)	=	2.5 acres

Volume (dry)

1 cubic centimetre (cm^3)	=	0.06 cubic inch
1 cubic metre (m^3)	=	1.31 cubic yards
1 cubic metre (m^3)	=	35.31 cubic feet
1000 cubic metres (m^3)	=	0.81 acre-foot
hectolitre (hL)	=	2.8 bushels

Temperature

F = (C x 9/5) + 32
C = (F-32) x 5/9

PUBLICATIONS FOR FURTHER INFORMATION

Publications * available from the Communications Branch, Ontario Ministry of Agriculture and Food, Legislative Buildings, Toronto M7A 1A5, from County Offices of the Ministry; or from the Extension Horticulturist serving your area.

NUMBERED PUBLICATIONS

27 *Starter Solutions for Vegetable Crops*
65 *Energy Conservation in Ontario Greenhouses*
284 *Ontario Farm Record Book (Horticultural and Cash Crops)*
313 *Mist Propagation*
365 *1985-86 Greenhouse Vegetable Production Recommendations*
485 *Growing Vegetable Transplants*

FACTSHEETS

290/092 *Air Pollution Problems in Greenhouses*
290/27 *Using Carbon Dioxide in Greenhouses*
290/518 *Soilless Culture of Greenhouse Vegetables*
290/518 *Sterilization of Greenhouse Vegetable Soils*
290/532 *Leaf Analysis for Greenhouse Vegetable Crops*
290/717 *Commercial Applications of Supplementary Lighting in Greenhouses*
290/717 *Supplementary Lighting in Commercial Greenhouses*
291/635 *Bacterial Canker of Tomato*
292/21 *Growing European Seedless Cucumbers*
293/13 *Greenhouse Lettuce Production*
295/15 *Seed-Propagated Free-Flowering Geraniums*
296/510 *Composts and Soilless Mixes for Transplants*

UNNUMBERED PUBLICATIONS

Standby Electric Power (Hydro)

AVAILABLE FROM ONTARIO MINISTRY OF THE ENVIRONMENT

Personal Protective Equipment for Pesticide Users
Chemical Safety Handbook
Pesticides Act & Regulations
Chemical Storage Signs

**For complete list, obtain most recent listing from sources indicated.*